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HIFI NEWS

JULY, 1975
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MATCHED OPTIONS SHOWN: Cassette Deck – TC 177SD. First cassette deck to rival open reel. Dolby*, 3 Ferrite heads. 20-20,000 Hz. with FeCr tape.

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[x]One of Sony's seven new Zodiac Hi-Fi Systems. See them at your dealer, soon.

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SONY

for particular people

ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 37 No 4

Solar cell costs have fallen so markedly in recent years that they are now an attractive proposition for a variety of practical applications. Our article on page 34 explains how they work, and describes a practical solar power supply system.

Designed around a pre-assembled module, this budget priced stereo record player should be easy to assemble and get going. Full constructional details commence on page 54.

On the cover

Exploring the universe and searching for signs of intelligent life, the giant Arecibo Observatory in northwestern Puerto Rico is the world's largest radio telescope. Several major improvements have been made to the telescope in recent years, as detailed in our story on page 32.

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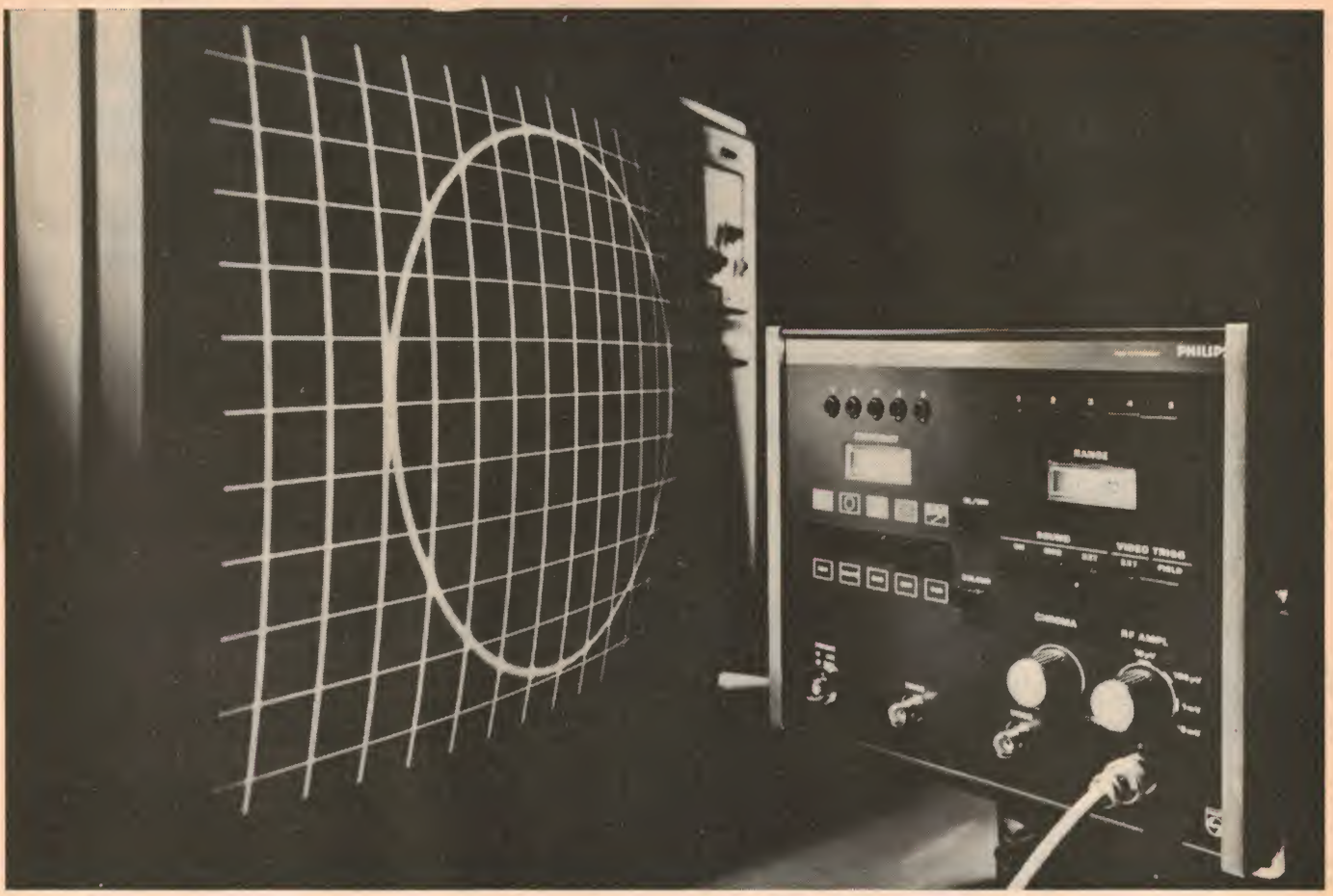

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Editorial Viewpoint

Quite a colourful achievement

One of the risks about being involved in electronics is that you can all too easily become a technical nit-picker, particularly when it comes to the electronic media. Whereas most people can relax and enjoy a stereo disc, FM or colour TV program, there is a tendency for we technical types to become preoccupied with the fine details of transmission or reproduction, to the point where we can get things right out of perspective.

But surely even the most critical of technical nit-pickers could not help admitting that in a few short months, our colour TV broadcasts have reached an extremely high standard. And having reached that standard, they are maintaining it consistently. How many times have you seen green faces, or any of the other troubles which still tend to occur elsewhere?

Personally I've been very impressed with the overall quality on all four local channels. At times it is virtually impossible to tell whether a live program is originating locally, from the opposite end of the country, or even overseas. And with programs which one knows must be on tape, it is mostly very difficult to believe that they are indeed "canned", and not live.

There's no doubt that colour television has come a very long way, and that our system and its implementation here in Australia have achieved virtually the full potential which can be currently realised. That's quite an achievement, surely, when you consider that regular monochrome transmission began only in 1956, and the first 625-line videotape machine in the country (and possibly in the world) was commissioned in 1958—only 17 years ago.

At times we Australians have an unfortunate tendency to denigrate our own efforts and achievements, and to be easily persuaded by those arguing that everything is done so much better elsewhere. But in this case at least, let's be realistic: already, our colour TV broadcasting is probably the equal of any in the world. And the credit for this is largely due to the many hardworking planners, engineers, technicians and operators in our stations, telecommunications facilities and standards authorities.

All of these people have done a splendid job, and have every right to feel proud of the achievement. Not that they are likely to want to rest on their laurels—from past experience, I've no doubt they're continuing to work for even better results.

So as you settle down to enjoy a relaxed evening, spare them a few thoughts of gratitude.

Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH.

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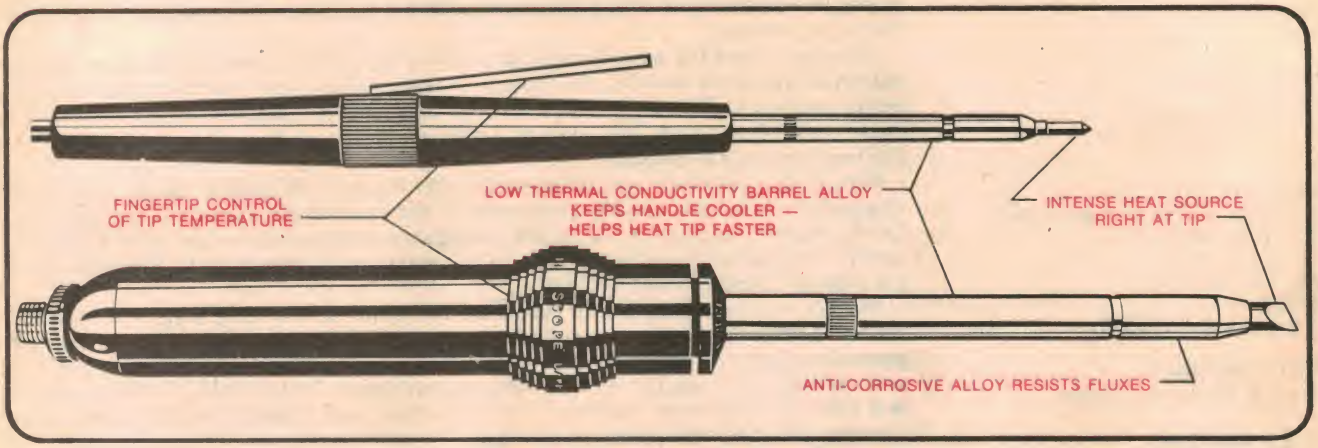

1. **Provide intense heating power:**
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3. **Put this heating power right at the tip:**
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With normal irons, you need several different sized irons to cope with various jobs and avoid the risk of dry or weak joints. Scope has designed an iron that does the work of any other iron from 10 watts to 150 watts.

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	Superspeed	Mini Superspeed
Low heat conductivity barrel	Yes	Yes
Non-corrosive barrel	Yes	Yes
Weight (without leads)	100 grm	50 grm
Heating up time for 40/60 solder from cold	5 sec.	5 sec.
Heating up time for aluminium solder from cold (450°C)	14 sec.	12.5 sec.
Heating up time for hard silver solder from cold (630°C)	32 sec.	29 sec.
A conventional iron to do the same work would need to be—	up to 150W	up to 75W
Diameter of barrel	9.5 mm	6.4 mm
Choice of copper tip shapes	Yes	No
Cable lugs fitted	Yes	Yes
User Preference Guide:		
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Electronic and Hi Fi hobbies	2nd pref.	1st pref.
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"LINTON 2". With a frequency response of 55-17,000 Hz. ± 3 dB. and a power handling capacity of 20 watts DIN, the compact "Linton 2" features a specially designed and sensitive 20 cm bass/mid range reproducer and a 5 cm high frequency unit. Size is only 48 x 25 x 24 cm. Ideal for floor or shelf In teak and walnut finishes

"MELTON 2". Features a very even frequency response from 45-17,000 Hz. ± 3 dB. and extends well beyond these figures. Handles 30 watts DIN with ease. Incorporates a 30 cm bass reproducer and a 5 cm mid-range treble unit, with crossover at 1500 Hz. Size is 53.5 x 37 x 26 cm. In teak and walnut finishes. For floor or shelf mounting.

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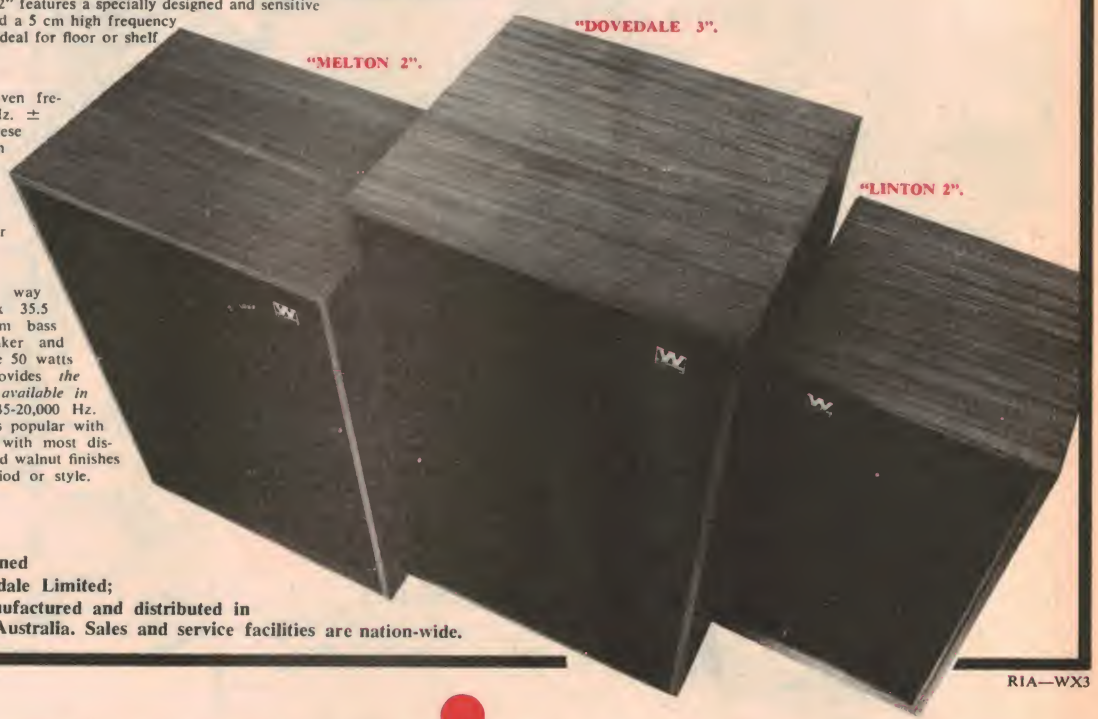

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CASSETTE DECKS EXPLAINED:

A cassette deck should not be confused with a cassette player. That would be like confusing a good stereo with a transistor radio. Instead, think of a cassette deck as you would a Hi Fi turntable. The only difference being one plays records and the other records and plays tape cassettes. Like a true Hi Fi turntable, the cassette deck is only one part of a Hi Fi sound system. It needs an amplifier and speakers to function properly. And, like a true Hi Fi turntable, it also costs. Talk is cheap. Good sound is not. Ask to see the full range of Kenwood Hi Fi equipment at any good Hi Fi Centre.

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Track System: 4-track stereo/mono recording and playback. Heads: Super Ferrite. Frequency Response: 30-16,000 Hz CRO 2 tape. Signal to Noise:*Dolby In—better than 58 db. Wow and Flutter: Less than 0.13%.
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*Recommended Retail Price.
**Averaged manufacturers' specifications subject to change without notice.
* Dolby is the trade mark of Dolby Laboratories.

KX-910**
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For optimum performance, we recommend BASF tapes.

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At least you know it's not the equipment's fault if you don't have to beat them off with sticks. Models illustrated are the AA930 AM/FM Tuner Amplifier, AP004 Turntable, GX600DB Dolby tapedeck, GX510D Vertical cassette deck, ASE22 stereo headphones and a pair of SW 156 Speakers. Recommended retail prices are $480.00, $294.00, $1037.00, $435.00, $29.00 and $366.00 respectively.

All AKAI Hi-Fi equipment is covered by the Complete Protection Plan. This means 12 months full parts and labour warranty, 12 months free insurance and a lifetime guarantee on all GX recording heads. So make sure the AKAI Complete Protection Plan warranty card is with your equipment. See your nearest AKAI Hi-Fi Professional now.

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Hi Fi News

"Capitol's new tape has everything!"

change, except for a rise in noise level when very lightly recorded passages were reproduced at exaggerated settings of the volume control. While other high quality cassettes might have also been able to give impressive results in similar circumstances, Joe Kempler was certainly able to make two key points:

- Ferric oxide cassettes can "deliver the goods" in hifi terms. The format has really come of age!
- Capitol's new cassette, in particular, can stand direct A-B comparison with a studio master—with a likely price advantage over other top brands.

Capitol's Joseph Kempler, the engineer responsible for the new Music Tape, at EMI's Sydney demonstration.

The musical comedy line "They've gone about as far as they can go" might apply to some things but presumably not to the design of cassette tapes. Capitol claim that their latest product in this field gives even wider frequency response and greater dynamic range than other ferric tapes; further, that it has superior mechanical qualities and a price advantage as well!

by NEVILLE WILLIAMS

Seeking to press home their point, Capitol, in association with EMI, recently arranged a demonstration at the US Trade Centre in Sydney, hosted by Mr Joseph Kempler, Manager of Advanced Technology for the Capitol Magnetics Division of Capitol Records.

For the demonstration, Mr Kempler brought out with him a 15ips master-quality tape from the Capitol studies in Hollywood, containing a variety of musical excerpts, the sounds of a steam train close up, and a fireworks display. The recording was notable for its wide frequency response, explosive transients, a tremendous dynamic range and very low background noise.

It was played, in the Trade Centre through an impressive array of top quality audio gear: Ampex AG440 15ips tape recorder from the EMI studios; Harmon-Kardon Citation 11 preamp and Citation 12 power amp; JBL Studio model 4320 loudspeakers, containing 15in woofer, compression type mid-range, horn/lens type tweeter. The sound was completely clean up to an ear-shattering level.

By way of comparison a copy of the same material on Capitol's new Music Tape cassette was played through a cassette deck typical of those commonly used by hifi enthusiasts—a Sony TC-134SD borrowed, off the shelf, from Instrol HiFi.

With the deck set to replay the cassette with Dolby-B compensation, the signal was fed to the amplifier and the tapes synchronised so that an instant switch could be made between the 15ips master and the cassette copy. With such a set-up, any reduction in quality would be very apparent indeed.

In fact, it was difficult to pick any

Capitol claims that their new audio formulation is the outcome of years of experience making computer tape. The gamma ferric particles are exceptionally small and uniform and applied in a binder which permits a very high particle density in the magnetic layer, still with effective isolation between particles.

According to company literature, the formulation results in lower background noise, more "headroom" to accommodate peaks into the red region of the recording metres, about 2dB greater output in the mid range and up to 8dB at 12kHz. Potential response range is claimed as from 20Hz to beyond 22kHz.

With figures like this, Joe Kempler suggested that it was difficult to justify the multi-layer concept and doping, and particularly the use of chromium-dioxide tape, with its special—an often unsatisfied—requirements of bias level.

On the mechanical side, Capitol research had shown that enthusiasts had experienced sufficient problems in the past to breed some distrust of the cassette format. Apart from poor design and poor quality control, some of the problems at least came from tape which tended to spool unevenly, producing a build-up which resulted in wow or complete jamming.

The new Capitol tape had a "cushion-aire" carbon backing which gave the tape a controlled friction characteristic, allowing each new layer to nestle against the one underneath, substantially preventing build-up and uneven spooling.

The carbon layer offered another advantage in preventing the build-up of static charges which could cause the outer layers in a stored spool to separate from the rest and be attracted to the cassette housing. Subjected to a sudden

When you record ordinary things, use ordinary tape. But when you record music, use the music tape™ BY CAPITOL

OK, why should I buy a special tape just to record music?
Good question. And the best, most simple answer is that with **the music tape** cassette you can expect a frequency response exceeding 20 Hz-22 kHz.

I might be impressed if I knew precisely what this technical stuff meant.
It means that you can hear music as it was meant to be heard, the 'snips' of the cymbals and the 'throb' of the bass. Take a piece of music like the Moody Blues 'Question of Balance' opening track: when this is recorded on **the music tape** cassette you can hear, on playback, everything that you heard in the original, the melody line played by the bass and the full impact of the acoustic guitar chords.

I get the impression that this cassette gives as good a response as a reel to reel tape.
Let's put it this way. With **the music tape** by Capitol cassettes, standard home cassette decks (not small portables but standard size) will give you a performance as good as many open-reel machines and far better than the average open-reel machine.

Are there any special recording tricks you need to get such a good response?
Not really. Just use a good cassette deck, make sure the Dolby is on, and make sure that the selector switch is **not** on CrO_2 but 'LN' (low noise).

Well that sounds simple, but isn't this CrO_2 switch for the best tape and if yours is as good as you say . . .
Hold on, hold on . . . the CrO_2 setting is exclusively for **chromium dioxide** tapes and because the setting is not standardised from one brand of cassette to another it will overbias all other cassette tapes.

But I'm told that those 'chromium dioxide' tapes are really good.
Well let's weigh up the evidence; **the music tape** cassette by Capitol is a true breakaway from the traditional iron oxide tapes, being a high-output, low-noise tape with superb frequency response (exceeding 20 Hz-22 kHz) which is as good as the very best chrome-dioxide tapes but, unlike them, it does not have the disadvantages of 'incompatibility' and 'high wear'.

So, you're as good as the very best with a couple of extra advantages as well.
That's right and that's why we say: 'when you record ordinary things, use ordinary tape; but when you record music, use **the music tape** cassette by Capitol'. And there's one more advantage.

What's that?
The music tape cassette by Capitol will retail at around 30% cheaper than any other quality-compatible cassette.

Say no more. I've got a lot of music to record.

On the music tape™ BY CAPITOL

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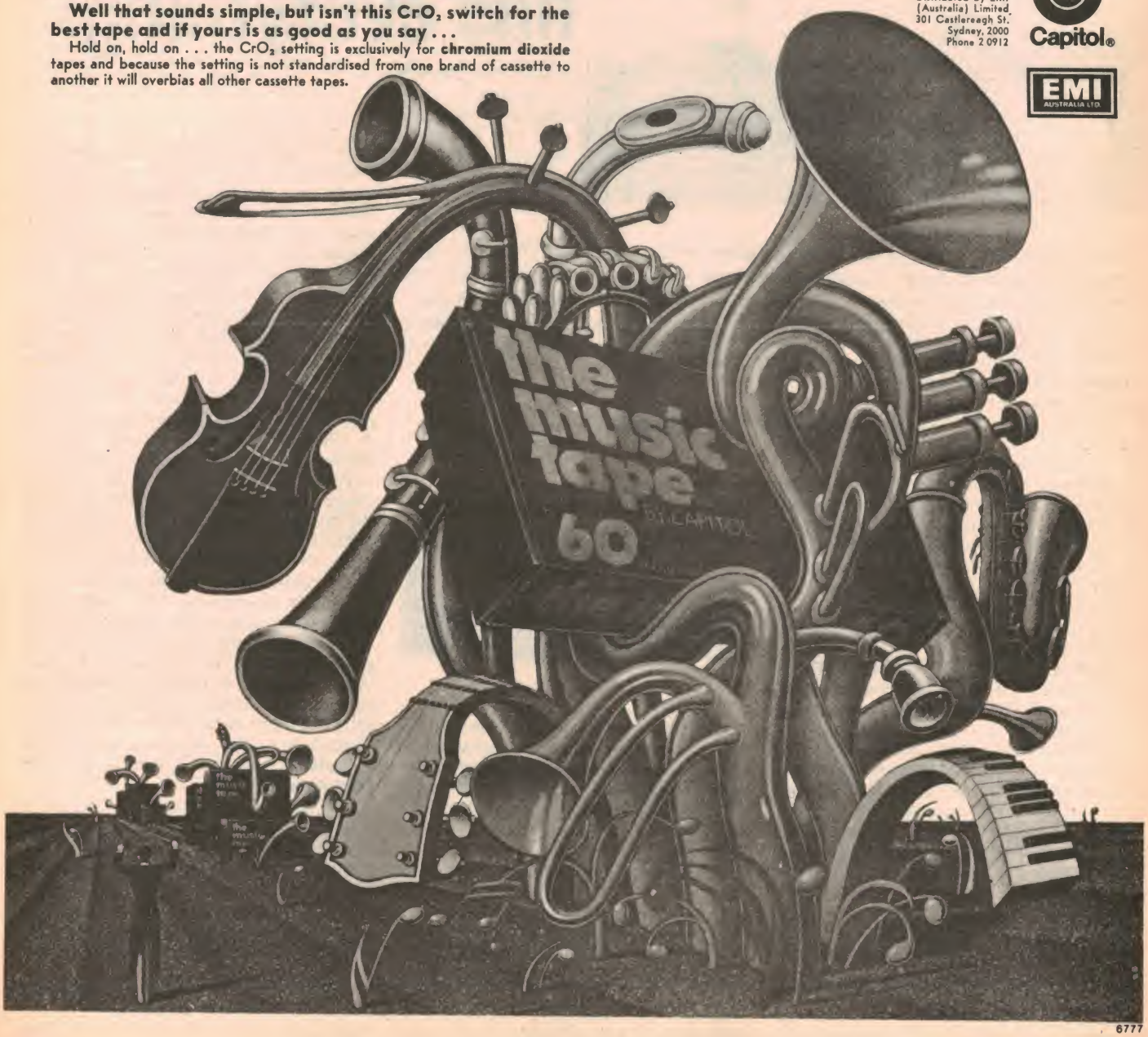

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snatch in a machine, the loose tape could be pulled into the space above the still-stationary biscuit, becoming caught up around the spigot.

In other respects, too, the cassette structure reflects the efforts of the Capitol research and design program. It is of screwed construction, allowing splicing in special circumstances. It has rotating guides, inside liners and a built-in mu-metal shield behind the pressure pad to help shield the replay gap.

For storage, customers will have the option of buying their cassettes in pairs in "stak-pak" containers, which are so designed that they can be locked together to become a neat cabinet. Each unit has a drawer containing two cassettes, with space on the front for a slip-in label card.

Capitol tape products are marketed in Australia through EMI Australia Ltd, through normal trade outlets.

While the Sydney demonstration was concerned primarily with Capitol's new cassette, there was a parallel release of information on an improved cartridge and improved tape for open-reel machines.

The cartridge takes advantage of the new pure oxide formulation as well as mechanical design of the mechanism to warrant the statement "guaranteed jam-proof"; this, despite the wide range of operating temperatures that cartridges are commonly exposed to.

For open-reel machines, there is little that the tape supplier can do to influence or improve the mechanics but, here again, Capitol say that their cushion-aire carbon backing provides predictable friction and spooling characteristics, virtually eliminating bunching and uneven wind attributable to the tape itself.

Electrically, the lower noise, wider response and greater headroom contribute to the end result and, according to Capitol, should make it possible for recordists with quality machines to drop back to 3-3/4ips with no evident loss in quality.

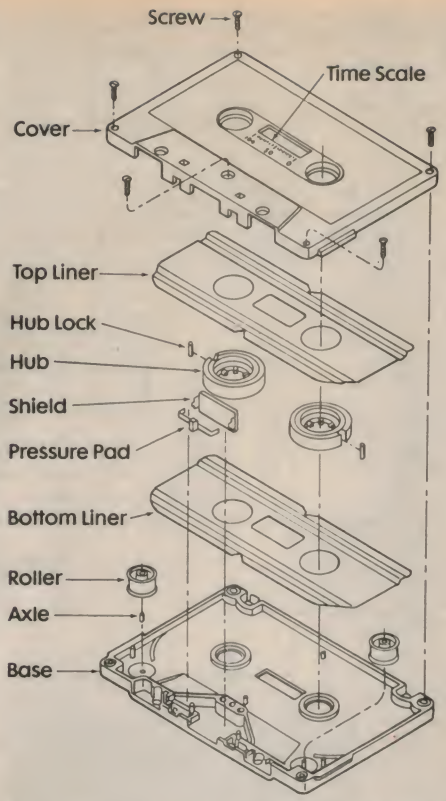
REEL-REEL TAPE: While casettes and cassette players dominate the tape scene in Australia, users of open-reel machines have not been forgotten—by TDK either!

TDK representatives in Australia, Convoy International, have advised that they now hold stocks of TDK's new reel-reel tapes: AUDUA (L-series) and S-series.

The message is that, while other low-noise tapes are good, the AUDUA (L-series) is better in terms of performance, more stable, and unaffected by environmental changes or prolonged storage. It can be recommended for both home and professional use.

The S-series is a "super-quality" low noise tape with a newly developed high density, high coercivity ferric oxide coating. It offers particularly good figures for signal/noise ratio, dynamic range across the whole spectrum, low distortion and low print-through.

Both tapes are available in 555m (1800 ft.) and 370m (1200 ft.) lengths but the AUDUA L-series is available also in 1110m (3600 ft.) lengths. (Convoy International Pty Ltd, 4 Dowling St, Woolloomooloo, NSW 2011).



An exploded view of Capitol's Music Tape cassette. The liners are thin membranes intended to help keep the tape edges in line. Cassettes available are C-45, C-60, C-90 and C-120.

ABC FM: The Postmaster-General (Senator Reg Bishop) has confirmed that the Australian Post Office is hopeful of having four FM transmitters in operation by Christmas, at a total cost of $150,000. Tenders for the supply of the transmitters closed on March 18.

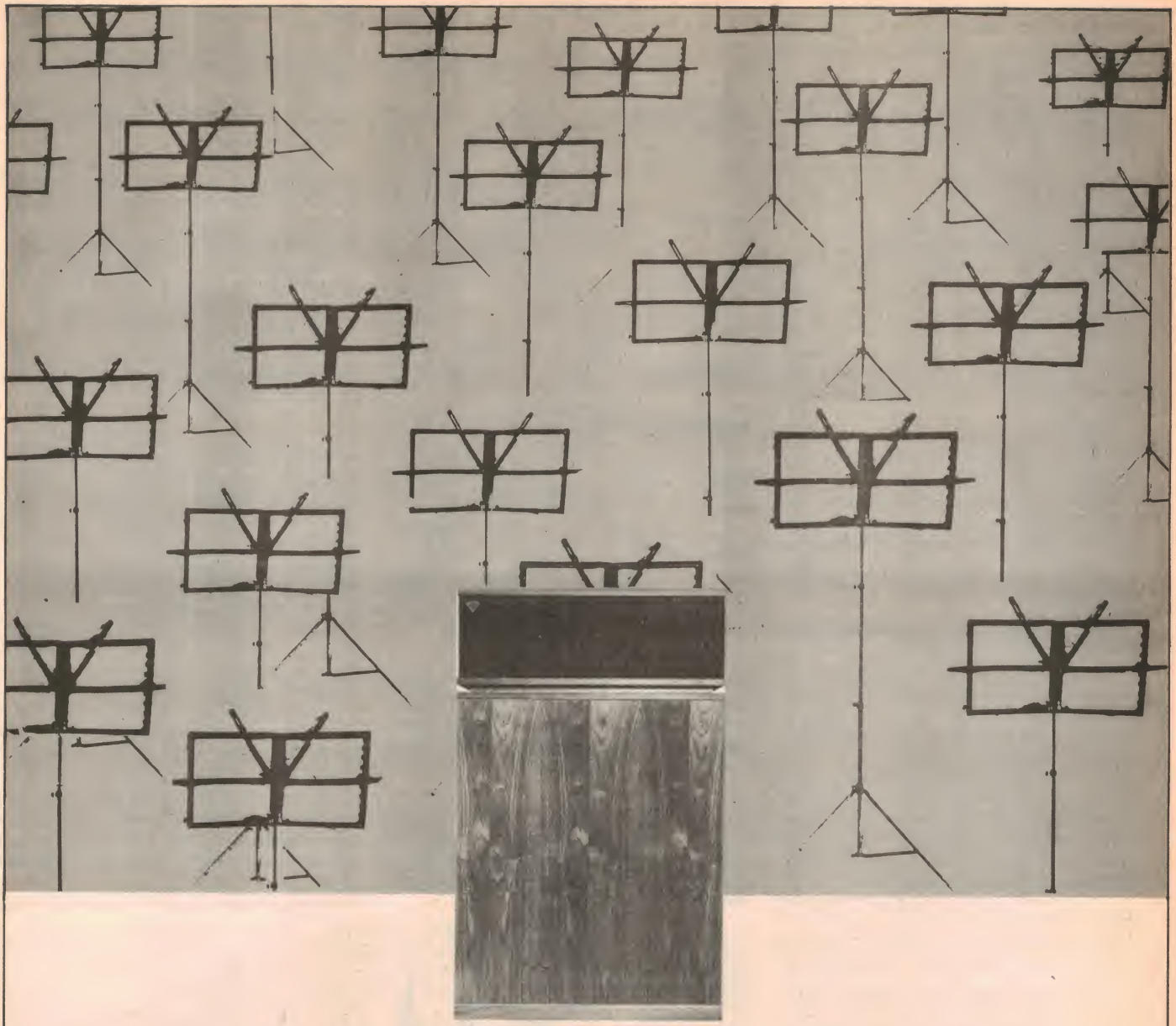
The transmitters will be operated by the proposed Australian Telecommunications Commission and will radiate a single common program provided by the Australian Broadcasting Commission.

The aerials will be sited atop the present APO television masts at Gore Hill, Sydney; Mt Dandenong, Melbourne; Black Mountain, Canberra; Mt Lofty, Adelaide. Effective range of the FM transmissions will be very similar to that of the TV transmitters.

AM/FM RADIO: One of the problems of public broadcasting in the United States is to maintain the viability of both systems: medium-wave AM and VHF FM. Legislation in the pipeline would have required that all radios manufactured or imported into the country and selling for $15 or more include coverage of both AM and FM stations. The immediate intention was to assist FM broadcasters but, in longer term, to guarantee audience access for both systems.

The legislation was adopted by the Senate but met problems in the Congress. The House Commerce Committee modified it so that the provision would apply only to radios fitted into new cars, but this stirred up the automobile lobby who maintained that they had enough trouble promoting sales and keeping down prices, without the Government throwing another spanner into the works.

Seeking to link the Company's traditions in the hifi field with a forward looking image, Peerless Fabrikkerne A/S of Copenhagen have just registered a new trade mark for their range of quality loudspeakers. The work of artist John K. Jonsson, it suggests four horns in a quadraphonic relationship. The picture shows the symbol being erected on the facade of the Peerless factory in Copenhagen. The company is represented in Australia by the G.R.D. Group Pty Ltd, of 698 Burke Rd, Camberwell, Vic 3124. Mr. R. A. Donaldson, Group Manager, says that his company now holds good stocks of the complete range of Peerless loudspeaker kits. Further information is available on application from G.R.D. at the above address.



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10995

As a result, the matter seems to have been quietly buried but FM broadcasters say that they will be doing their best to revive it. The FCC is on their side but most believe that they face an uphill battle to get it going again.

ROTEL "DOMUS": With dome type reproducers already firmly established as tweeters, "Domus" loudspeakers have gone one better with systems incorporating dome type drivers for the midrange.

Domus loudspeaker systems are manufactured in Spain for Rotel and are distributed in Australia by International Dynamics (Agencies) Pty Ltd, of 23 Elma Rd, North Cheltenham, Vic. 3192.

Altogether, there are 5 Domus models (150, 200, 250, 350 and 450) all using sealed enclosures and acoustic suspension drivers to handle the bass end.

International Dynamics claim that the Domus series of loudspeaker systems mate particularly well with the standard series of Rotel amplifiers. A pair of 250 systems with a Rotel 211 amplifier is said to be particularly good value.

SOUND QUALITY: It is common practice in television, nowadays, to include test data in the blanking periods which allows the quality of links to be checked continuously at the receiving end and, where possible, for limitations to be compensated. A real time quality checking system would be welcome for sound transmissions but the means have not been obvious because sound signals are continuous, with no convenient blanking periods into which test data can be buried.

Rohde & Schwarz may have a possible answer with their "Audiodat" system which was worked out in broad detail by an ad hoc commission on sound test signals composed of members of ARD (Association of Federal-German Broadcasting Corporations), FTZ (Federal-German Central Telecommunications Authority) and IRT (Federal-German Institute for Broadcasting Technology).

Reports indicate that the audio signal itself is used to provide the reference data. Prior to transmission, material to be sent is analysed by Audiodat equipment to determine certain parameters, presumably having to do with frequency and dynamic characteristics, etc. These parameters are transmitted just ahead of the program, allowing operators at distant points to analyse what they receive, using similar Audiodat equipment, and note any discrepancies in the analysis.

SUPERSCOPE "SUPER": Whatever the sales climate before or since, the American company Superscope Inc. certainly had a ball in 1974, with a record sales figure of $157,200,000.

Superscope manufacture home entertainment products under their own name, and also distribute and manufacture Marantz high fidelity components, well known in this country. For good measure, the company also has sole distribution rights in the USA for all Sony model tape recorders that include stereo cartridge, stereo reel-to-reel or stereo cassette decks.

Marantz products are distributed in Australia by Auriema (A'Asia) Pty Ltd, while Superscope products are distributed by Allans Music Pty Ltd.

CINEMA STEREO: In a big, plushy theatre showing big plushy films, the provision of high quality multi-channel sound is no problem: the theatre has the necessary equipment and the release prints come complete with the appropriate tracks—invariably recorded magnetically.

Outside this area, the small budget situation takes over. Film makers can't afford to hire expensive multi-track magnetic prints for inadequate return, and small theatres can't afford heavy hiring charges or the cost of "state of the art" projection equipment. As a result, they and their patrons can look forward only to standard mono optical prints.

There have been attempts at various times to contrive stereo effects from mono tracks by subsonic cueing, etc, with the idea that local theatres can reproduce in stereo or mono according to the equipment available. However, such schemes seem to have enjoyed only limited success.

In Britain, Dolby Laboratories are having a crack at the problem by splitting the standard optical track into two and substituting a side-by-side stereo pair, which can be used in much the same manner as stereo in the home to create an apparent sound stage. Equally, the tracks can be scanned by a single wide light-slit, for ordinary mono sound, thereby preserving compatibility.

It is by no means a new idea and was, in fact, demonstrated in Australia, during the 1930's by the late Raymond Allsop, in conjunction with his then Raycophone Company. However, the method has failed to negotiate two major problem areas: (1) reduced signal/noise ratio, imposed by the narrower tracks and sensitive to film condition and (2) reduced effective modulation, as seen by existing mono scanners.

Dolby Laboratories say that the signal/noise problem can be licked by modern anti-noise techniques—an area in which Dolby has acquired enormous expertise.

They are also optimistic that adequate effective modulation can be provided to cope with older, lower-gain mono equipments installed in many theatres. Apparently this optimism is not shared universally within the industry on the grounds that some theatre equipments have nothing to spare in terms of gain, even with some standard films; it is not certain that they can cope with the resolution loss occasioned by a black "land" right down the middle of the optical aperture!

National Panasonic have added a new cassette deck to their range which combines Dolby and CR02 facilities with a particularly attractive price for a quality unit: about $A219.00. In addition, it features a super permalloy R/P head, auto stop and a pause button, as well as the usual controls, tape counter and twin level meters. Response is to 13kHz (CR02 tape), wow and flutter 0.15% (RMS). For more details: Haco Distributing Agencies Pty Ltd, 57-69 Anzac Pde, Kensington, NSW 2033.

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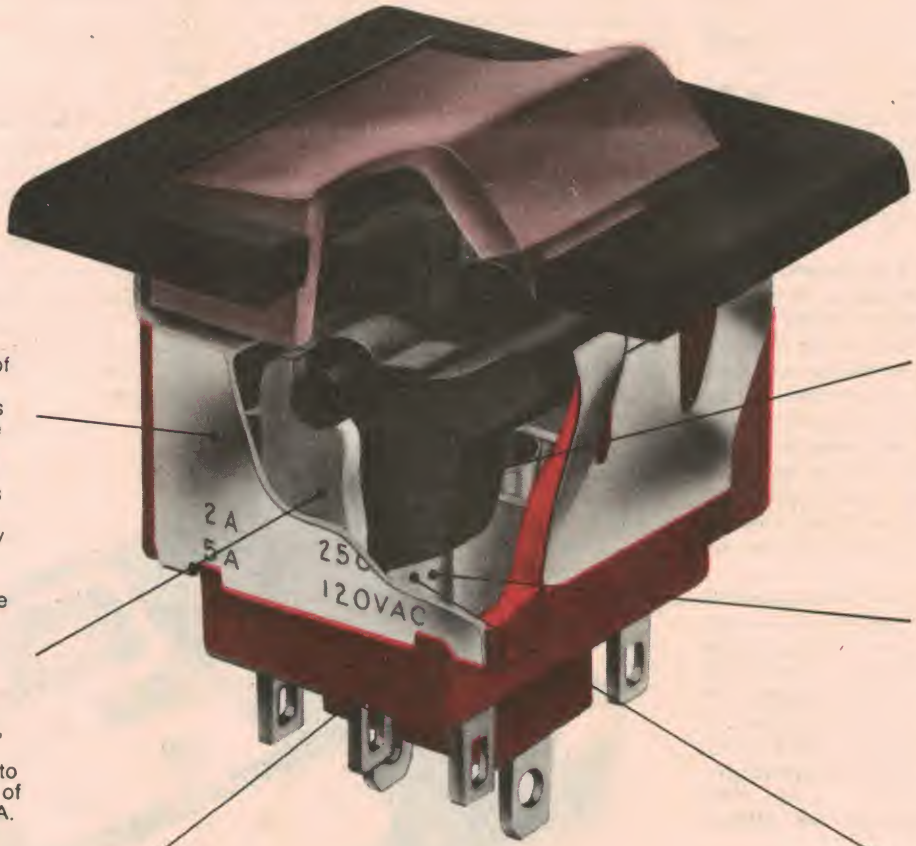

1 The switch clamp of ¼ hard temper stainless steel resists up to 8 lbs. pressure required to dislodge switch through mounting panel. This switch offers more than twice the rigidity of other brands.

2 Cradle supports are designed to give positive cradle alignment at all segments of actuation. This ensures a consistent, crisp "switch feel", a contributing factor to the broad popularity of this switch in the USA.

3 C & K switches are superior through the use of scientifically selected materials and analysis of engineering design failures in competing brands. The case assembly of this switch is of glass reinforced Diallyl Phthalate (DAP) . . . the finest material available for the purpose.

4 Fine tolerance control of cradle trunnion support post mouldings ensures accurate fulcrum contact sweep. The design offers total circuit option of the range . . . a real plus point when compared to other brands.

5 Durable contact follower has been life tested to some 255,000 cycles—far in excess of the advertised 100,000 cycles. This follower is screw machine cut Teflon, a unique feature making this switch far superior to other brands employing moulded phenolic or thermoset plastic contact followers.

6 No inbuilt lubricant —High-lubricity contact follower eliminates the need for "dirt-attracting" lubricant on fulcrum contacts.

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AC107

SOME FM TERMS EXPLAINED

As Australian hifi enthusiasts begin to look more closely at FM tuners and receivers, they will need to interpret the performance specifications which relate to these units. Below, some of the terms are explained that may be encountered:

USEABLE SENSITIVITY, often referred to as "IHF Sensitivity" indicates the ability of a tuner to resolve very weak ("fringe" or "DX") signals—an ability depending both on the overall gain of the tuner and the amount of inherent noise it produces under high gain conditions.

Useable sensitivity, then, is expressed as the smallest fully-modulated FM signal from which the tuner can derive the desired audio component 30dB above the total extraneous content of noise and distortion. To perform the test a very sharp filter is necessary to isolate the modulating tone for measurement purposes.

A signal which is only 30dB above the extraneous background is listenable but well short of even modest hifi standards, no matter what its other merits.

Typical well designed FM tuners have a useable sensitivity of 2 microvolts or less—the smaller the figure, the better the tuner is likely to be on very weak signals.

Useable or IHF sensitivity normally assumes mono mode, since the noise level in stereo mode with such low input would be quite prohibitive. Many FM tuners remain in mono mode automatically unless the signal strength exceeds a predetermined mimimum.

QUIETING SENSITIVITY is a somewhat similar rating, but one which seeks to express the ability of a tuner to suppress noise on weak signals sufficient to satisfy reasonably good listening requirements. It represents the minimum input signal which will ensure that the recovered modulation is 50dB above the tuner's noise content. Distortion is not included in this test, which can therefore be performed on a simple modulation on/off basis, without the use of a sharply tuned filter.

Typical good quality tuners exhibit quieting sensitivity figures in the range 3 to 7uV for mono mode.

For stereo mode, all the foregoing figures should typically be multiplied by up to 10 times so that "useable sensitivity" in stereo mode might be in the vicinity of 20uV, while quieting sensitivity for stereo would fall in the range 30-70uV. Probably because the figures for stereo mode do not look all that good, they are rarely publicised.

ULTIMATE QUIETING: used as an alternative term to ultimate signal/noise ratio, being that obtained with a large input signal typical of a strong signal area. A figure of 1000uV is commonly used as a basis for this measurement and, with this input, typical good quality tuners exhibit an ultimate quieting of 60dB or more, for both mono and stereo. Measurement beyond 70dB is likely to be compromised by the noise content of the test equipment itself.

SIGNAL/NOISE RATIO: a self-explanatory term, which can be expressed in decibels and relate to any stated input level, and for mono or stereo mode. If not so qualified, it can be taken to mean the S/N ratio under typical use conditions and then means the same as "ultimate quieting". A fine point which sometimes emerges from an inspection of data is whether the "noise" content also includes mains or power supply hum. If a tuner is to be really quiet, the noise—including hum—should be 60dB or more down.

INPUT SIGNAL LEVEL is still commonly expressed in microvolts (uV). An emerging standard introduces the concept of signal input power, expressed in decibels and related to a femtowatt scale. As a rule of thumb, OdBf equals 1.1uV under standard laboratory conditions. As such, an FM tuner with a useable sensitivity of OdBf would be outstanding and figures up to 6dBf—approximately twice the voltage (2.2uV) or 4 times power—would be more typical and adequate.

Motional Feedback:

A DIFFERENT APPROACH TO LOUDSPEAKER DESIGN

Seeking a major impact on the Australian hifi market, the Philips group have announced the local release of two important new products: their RH532 motional feedback (MFB) loudspeaker system and the 209S electronic turntable, the latter complete with arm and cartridge. In particular, the RH532 represents a complete departure from normal design practice.

by NEVILLE WILLIAMS

In one sense, the RH532 motional loudspeaker system is not news, because it has been making the headlines overseas for some months. Towards the end of the last European summer, for example, it was one of the highlights of a visit by hifi writers to the Eindhoven complex. The time has now come for a full-scale promotion on the Australian market so that local enthusiasts will have the opportunity, not just to read, but to buy.

In essence, the RH532 MFB (motional feedback) loudspeaker is Philips' attempt to solve the tantalising problem of achieving high-level high-quality sound from the smallest possible system. Technically, the MFB principle is not limited to small systems but they are the ones where the design problems are greatest, notably at the bass end.

If there is no urgent constraint on enclosure volume, the designer can choose a generously dimensioned bass driver and provide appropriate acoustic loading—tuned port, passive cone, absorbent column, or "infinite baffle". With proper design, adequate bass response and power handling can be obtained by any of these methods.

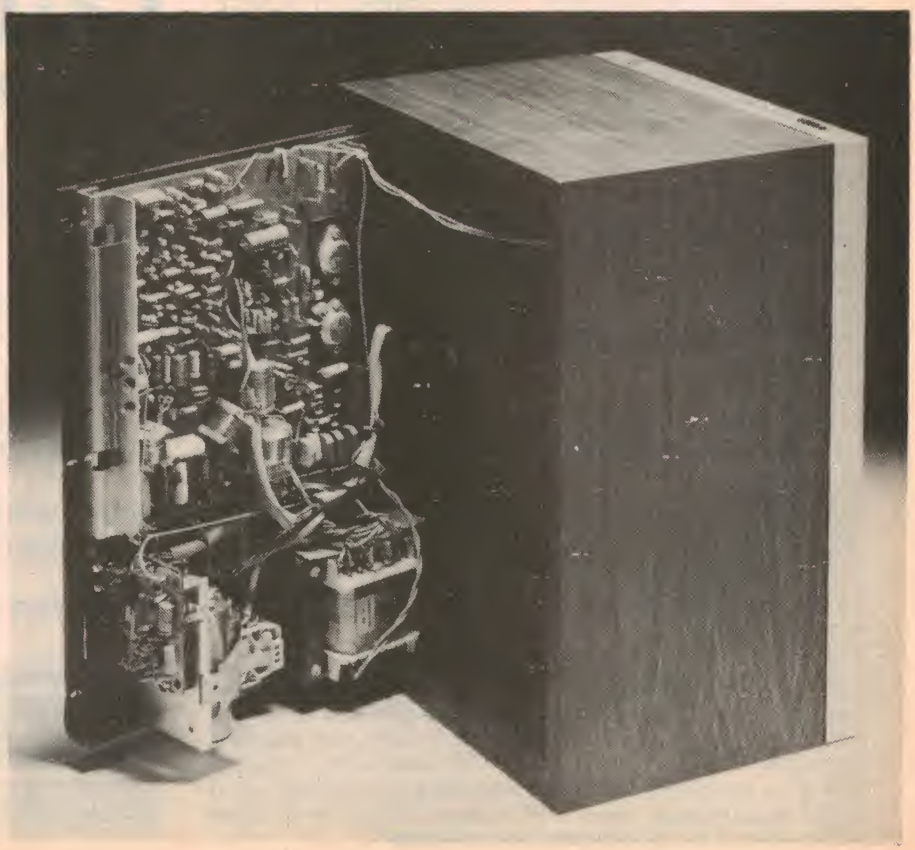
However, as enclosure volume is reduced to meet customer requirements, the area of the driver cone has to be reduced along with it, so as not to prejudice unduly the ability of the system to respond to low frequency drive. At the same time, in the interests of acoustic output, the smaller cone must be designed for substantial travel to help compensate for its lack of area, and this poses its own problems.

In the ultimate, the designer of a compact system has to weigh up various compromises in order to come up with an end product which exhibits a logical balance in terms of size, frequency response, sensitivity, power handling capacity and distortion content.

It is a tribute to their efforts that many modern, compact loudspeaker systems are capable of producing a sound level and quality which would have been unthinkable a few years ago from enclosures of comparable size.

One of the tantalising things about loudspeaker design is that the transducer system is not amenable to the application of negative feedback as a counter to non-linearity. Elsewhere in the reproduction chain, feedback is used freely, modifying the signal voltage right up to the voice coil terminals. But the behaviour of the voice coil in the magnetic field, and of the cone in the acoustic field, is something that is normally external to any practicable feedback loop. Linearity is entirely dependent on electroacoustic design and, as already stated, this involves heavy compromises in scaled down systems.

At various times, attempts have been made to introduce feedback around the loudspeaker by a double coil system—



The rear metal panel of the RH532 swings out to provide free access to the amplifiers, cross-over network and power supply, the panel itself acting as a heat sink. Internal sealing of the 9-litre acoustic chamber is independent of the amplifier assembly.

one to drive the cone, the other to provide a feedback component hopefully proportional to voice coil movement. The most obvious weakness of many such systems has been that the coupling between the coils has been as much inductive as electro-mechanical. Separating the coils to avoid this effect rapidly leads to a situation where the yield is not worth the complication.

In any case, the behaviour of a cone only relates reasonably to that of the voice coil former over the frequency range where the cone acts a rigid piston. Therefore, while electroacoustic feedback may be helpful and important over the "piston" bass range, it becomes meaningless and randomly inappropriate above that range. This leads to a further problem:

Even if a designer did manage to produce a system with a feedback source meaningful over the important piston bass range, how could the system possibly relate to standard amplifiers having no provision for an external—and frequency selective—feedback input?

Not surprisingly, the whole approach has largely been bypassed.

Some time ago, however, it was taken up again by the Dutch Philips organisation, in an effort to linearise a proposed new line of compact loudspeaker systems. The starting point would be one (or more) designs based on proven woofer(s) and an appropriate sealed and padded enclosure—with mid-range and tweeter units to handle the higher frequencies. To this point, the systems would be normal, and good, by ordinary standards.

The next step would be to add a transducer to the woofer cone assembly, to generate a voltage proportional to cone movement. Injected into the driver amplifier as negative feedback, it would tend to outphase non-linearity, hopefully forcing the cone to track the electrical drive; this, despite mechanical and acoustic influences which might try to make it do otherwise. Response peaks, non-linearity and harmonic mode travel would all (again, hopefully) be substantially reduced, even in the range below cone resonance.

For the feedback transducer, Philips attached a tiny ceramic piezo-electric "accelerometer" to the apex of the cone, thereby avoiding magnetic coupling effects and significant mechanical complications. Being attached only to the woofer, in turn required to handle frequencies only within its piston range, the resulting voltage can be regarded as a valid "sample" of what the woofer cone is actually doing.

While the scheme sounds simple enough, reduced to these terms, the relevant literature hints at a problem which has not thus far been mentioned: In the vicinity of system resonance and below it, a loudspeaker exhibits steep changes in impedance and phase, particularly where a small enclosure is involved. Within an ordinary feedback loop, such changes would almost certainly lead to instability. It is therefore essential to build into the loop circuitry adequate corrective phase and gain characteristics.

The RH532 (above) looks much like any other enclosure from the front, although it is heavier than usual. Even with the fret removed (below) the only hint of difference is the indicator light to show "standby" or "fully powered", according to its brightness. The MFB concept would seemingly demand a sealed system since, with other enclosures, there would be bass output other than from the woofer cone.

This done, resonance virtually disappears, as far as cone travel is concerned and, in fact, cone travel becomes a substantially linear function of drive voltage down to 35Hz. At this frequency, the response is best rolled off electrically, serving as a built-in rumble filter.

To avoid complications with the driver amplifier, Philips simply developed the project as a powered loudspeaker, with the main power amplifier built right into the loudspeaker enclosure. In fact, they use two amplifiers: one to drive the woofer and the other, somewhat less powerful, to drive the more sensitive mid range and tweeter loudspeakers.

Use of the two amplifiers makes it possible to deal separately with the problems peculiar to the MFB controlled woofer and, of course, to balance the bass/mid/treble response. Ahead of the amplifiers, a low-level active divider network splits the input signal at the selected main crossover, frequency with a slope either side of 18dB/octave.

The first of the Philips MFB range, and the one which is pictured here, is the RH532. It is of typical "bookshelf" size measuring, overall, 283 x 378 x 212mm. Frontal area is roughly the same as this magazine opened out flat, and with a depth of 212mm or about 8 inches. The internal volume is 15 litres but only 9 litres form the actual acoustic enclosure. A 6-litre compartment at the rear encloses the electronics.

Significantly, into the 9-litre acoustic space, Philips have been able to pack three loudspeakers: a 200mm 4-ohm woofer (AD 8065/W4), a 125mm 8-ohm mid-range (AD 5060/Sq8) and an 8-ohm 25mm dome tweeter (AD 0160/T8).

The woofer is driven by a 40W (cont) amplifier operating in the range 35-500Hz—the latter frequency determined by the 18dB/octave electronic crossover at its input. A second, 20W amplifier handles all frequencies above 500Hz, with a passive L/C/R network diverting its output from the mid-range unit to the tweeter at a nominal 3500Hz, and 12dB/octave.

Philips rate the system as having a "total power" of 60W (cont), which is strictly true. However, the effective acoustic output would probably be determined by the 40W low frequency amplifier and the acoustic efficiency of the 200mm woofer. It is on this basis that the potential of the system can be compared with that of a conventional power amplifier operating into conventional passive loudspeaker systems.

Since the RH532 is a powered system, it can logically be driven from a preamplifier/control unit having an appropriate output voltage and impedance level. For this role, the RH532 needs a signal input level of 1V (presumably RMS for full output). It has an input impedance of 3000 ohms, which may be too low for some preamplifiers to work into. Philips' own overseas (USA) equipment line includes a preamplifier (SC 102) designed for the purpose. A modified version of this preamp. (RH 551) intended for the European and Australian markets, will be available here in a few months' time.

Philips have envisaged, however, that the units may be used with integrated receivers and amplifiers having normal (but modest) power output stages. For

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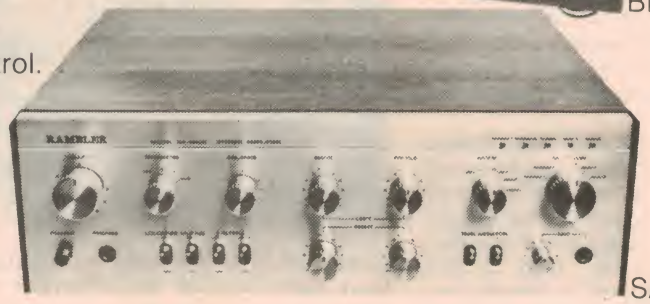

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MR 160

this role the RH532 can be switched so that it presents a 35-ohm load to the source amplifier, and requires 3V of signal drive. Under these conditions, approximating about the 1W level with normal load, even a modest output stage should be capable of providing a clean signal. Effectively, addition of two RH532's will transform it into a powerful 40+40W or 60+60W system, according to how the ratings are interpreted.

For use with a more powerful amplifier, a third position sets the RH532 for an input of 7.5V at 25 ohms. While the advantage of extending a high powered amplifier may be less obvious, the makers are convinced that their MFB system will find support from enthusiasts who want to make absolutely the best use of limited space.

Apart from provision to adjust input voltage and impedance, the RH532 is designed with an eye to convenient input connections. One cable only is necessary between the amplifier or preamplifier and the most accessible speaker system. All further connections can be run between loudspeakers and the role of each—left channel or right channel—can be selected while so doing. In fact, as many as 15 units can be interconnected to each channel for special installations providing a modular way of achieving an 1800W total power for stereo or a whopping 3600W for quadraphonic!

One of the nuisance aspects of conventional powered loudspeakers is that they all have to be separately switched on prior to use and then off again. Either that, or the mains supply has to be distributed from the preamplifier, which may or may not be convenient to arrange.

By contrast, the Philips RH532's can be connected to an adjacent power point and left switched on more or less indefinitely. In this "stand-by" condition, only the initial stages of the amplifier are powered, drawing negligible current, while a lamp glows softly as an indication that the system is ready for action. Immediately an input signal is received, an internal relay is triggered, brightening the indicator and powering the output stage in less than 1 second. If the signal ceases, the relay remains closed for 2-3 minutes, then opens, switching the power stages off again.

Thus the user needs only to switch off the central equipment—preamplifier, turntable, deck, etc—leaving the powered loudspeakers to look after themselves.

All very cunning—but how does the RH532 perform?

Reviews generally have been favourable. In the middle and upper register it is smooth, with no more or no less characteristic colouration that one would expect of a typical mid-range/tweeter combination.

It is at the bass end, with the motional feedback playing its part, that the system evokes most comment. Output is maintained smoothly down to 40Hz, dropping by about 4 or 5dB nearing that extreme. But, while this leads to adjectives such as "absolutely uncoloured", the lack of any 60 to 80Hz prominence is the possible reason why some have judged it subjectively to lack the "warmth" of conventional systems.

But, this point aside, there is common agreement that the performance is outstanding for such a modest looking system—a reaction which Philips seem to find at the one time pleasing and frustrating: pleasing because one objective has been achieved; frustrating because they see the RH532 as not just a good performer by "bookshelf" standards, but a top performer by any standards!

The new fully automatic electronic turntable, model 209S, recently announced in Australia by Philips. Three sensing switches attached to the underside of the turntable determine record size and speed.

It would certainly need to be, because the RH532 is by no means cheap. They are normally sold in pairs at a recommended retail price of $698.00 (per pair).

At the hifi visit mentioned earlier, correspondents were invited to listen to a 5-man jazz combo playing in the audition room. At a particular point in the performance, the drummer laid down his sticks, lit a cigarette and casually walked off—while the drum sound continued as normal.

This disappearing act was repeated, in turn, by the four remaining players, each having been replaced at the appropriate instant by a pre-recorded version of the performance. What impressed the audience was not so much the demonstration, which has been done before, but the opening of the backdrop to reveal two seemingly small and lonely RH532's reproducing the total sound.

A companion product at the Amsterdam release, last year, and in Melbourne this year, was the Philips automatic electronic turntable 209S.

Designed expressly for the specialist hifi market, it reduces record playing to the ultimate in simplicity. The user switches it on, places the desired record on the turntable and returns to his or her chair. The player senses the presence and size of the disc, selects the appropriate speed and lowers the pickup gently into the start groove. At the end of play, a photoelectric sensing circuit, triggered by the run-in groove, returns the pickup to rest and switches the player off.

While this mode of operation should cover most requirements most of the time, the user can exercise as much manual control as desired, including the selection of individual tracks or automatic repeat of any given disc.

For fully manual control, a smoked glass cover is slid aside, automatically linking the mechanism to a group of operator controls in a covered 2 "cockpit". At the same time, illuminated windows indicate "manual" operation and the speed for which the turntable is currently set. Access is available to the anti-skating adjustment and to a vernier speed control.

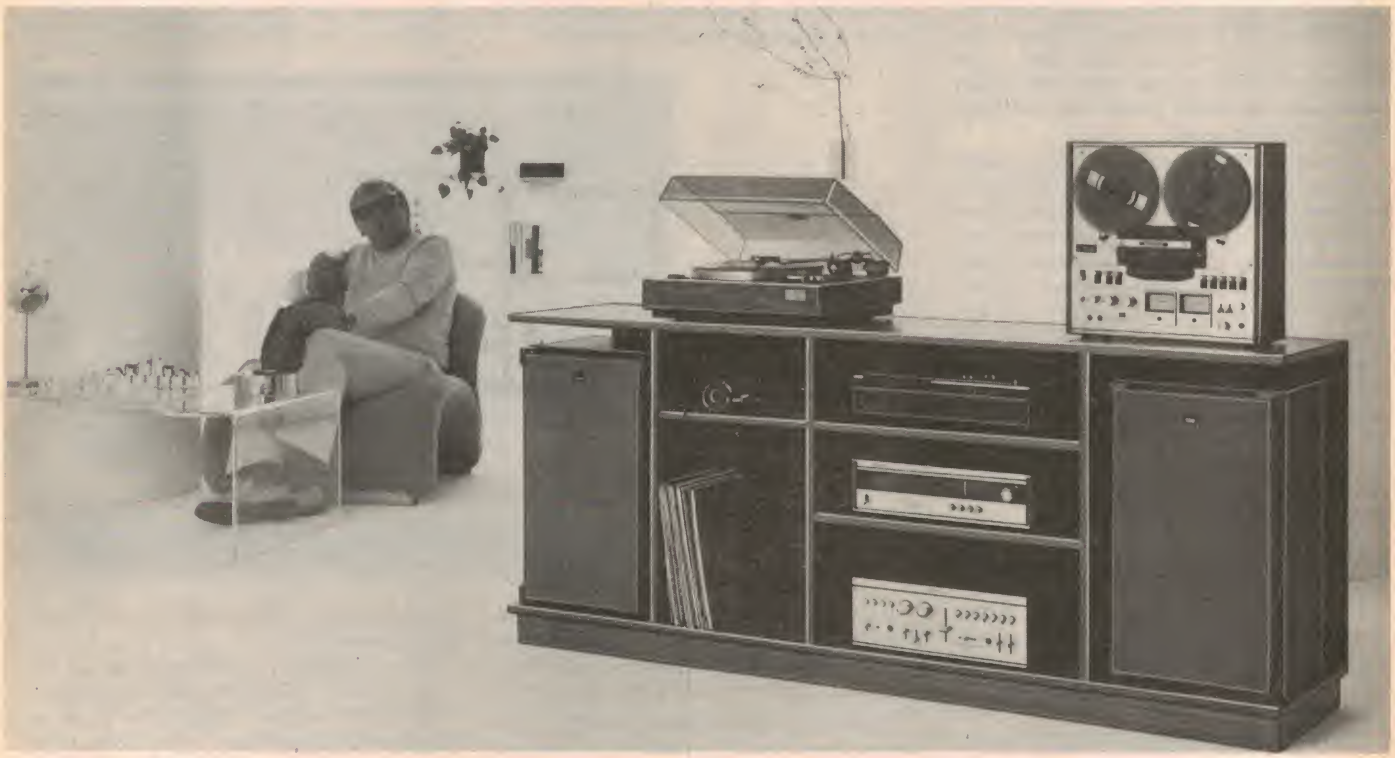
The turntable is powered by a DC motor which is, in turn, precisely speed-controlled by what Philips refer to as an electronic tachometer. It drives the turntable through a belt in order to achieve maximum isolation between the drive mechanism and the turntable itself.

As part of the isolation, the turntable is mounted on a sub-frame with compliant isolation from the main housing and the motor mechanism and control.

Two speeds are available—33⅓ and 45 rpm—adjustable to plus and minus 3%. Once set, speed is constant to within 0.2%, with wow and flutter not more than 0.08%. Rumble is −43dB (DIN A) or −65dB (DIN B).

The arm fitted to the 209S is finely engineered and suitable for use with high performance cartridges with tracking weights in the range 0.75 to 3 grams—including cartridges intended to play CD-4 or UD-4 discrete quadraphonic discs. The player is normally supplied with Philips own GP412 cartridge, from the super M range, but any other cartridge meeting the ½-inch RETMA specifications can be used. Recommended retail price of the 209S, complete with cartridge, is $349.00.

If everything you wanted to know about Hi-Fi seemed too complicated, Sony has a beautiful answer for you.



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Powerful Integrated Amplifier – TA 1150. with 100 watts/8 ohms I.H.F. constant power. Direct-coupled circuit – 2 tape recorder inputs. Wide range of controls. Frequency response: 12 Hz.-150 k Hz. Signal-to-noise extremely low. Total harmonic distortion under 0.1%.

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[x]One of Sony's seven new Zodiac Hi-Fi Systems. See them at your dealer, soon.
*"Dolby" is a trade mark of Dolby Laboratories.

Apan BFU-121 series 4000 automatic turntable

Just over a year ago in June 1974 we reviewed the Apan BFU-121 and found it a good buy. Here we review the new 4000 series model, which has been restyled and has a new magnetic cartridge with improved specifications. It is supplied complete with walnut base and perspex cover.

The new Apan series 4000 turntables have slightly larger decks and have the 4-pole synchronous motor mounted at the rear left-hand corner, which situates it as far away as possible from the magnetic cartridge. Dimensions of the player deck are 410 x 315mm.

Outside dimensions of the larger base and cover to suit are 455 x 175 x 362mm (W x H x D) while the tinted perspex cover required 80mm clearance at the rear to open fully. A full size template with complete mounting instructions is available upon request if you buy the turntable without base and cover.

Normally, the Apan BFU-121 is supplied packed in a carton while the base and cover assembly is in another carton. Assembly of the two takes only a short while when following the brief and concise instruction manual.

The platter is a 30cm aluminium diecasting weighing 1kg and is driven by a 5mm wide polished neoprene belt. The speed change mechanism has been restyled and now uses push-buttons to shift the belt up and down the stepped motor pulley.

A rotating counterweight on the tone arm provides horizontal balance as well as setting the tracking weight. Calibrations are provided in ½ gram steps. We checked the tracking weight at several settings and found it accurate to within better than 10%.

As with just about every other turntable these days, the removable headshell has the EIA locking collar, standard lead colour-coding and slotted cartridge mounting holes for stylus overhang adjustment.

Remaining features of the turntable are identical with the previous model. A small lever on the control panel provides damped lifting and lowering of the arm for manual operation but is also brought into action during automatic operation.

Two control levers and push-button are provided for automatic play modes. One selects the record size and thereby the cartridge set-down point while the other, together with the concentric push-button provides the functions such as Auto start, Stop, Manual, Repeat and Reject.

At all times the BFU-121 functions quietly and seems jamproof. The main drive cam gear is made of nylon instead of the zinc diecasting found on many record changers, so it should remain quiet.

We found that the automatic stop mechanism of the turntable requires 1 gram in order to function reliably, which means that it should not be used with high compliance cartridges. However, it is quite compatible with cartridges used for CD-4 reproduction since these normally require 2 to 2½ grams.

Because of the mechanism attached to the tone arm to operate the Stop mechanism, lateral friction in the arm is high enough to effectively "swamp" the force applied by the anti-skating lever and weight system. This means that on the automatic model, at least, the anti-skating feature is little more than a gimmick. In any case, the anti-skating is not adjustable as it would have to be to obtain optimum results.

Before readers jump to the wrong conclusion, it should be remembered that anti-skating compensation merely allows a slight improvement in cartridge waveform and tracking for a given tracking weight setting. Much the same degree of improvement can be obtained by slightly increasing the tracking weight.

To explain further, anti-skating compensation really only gives a worthwhile improvement with cartridges tracking below 2 grams. Since the Apan turntable under review is normally supplied with a cartridge intended to track at about 2½ grams, the anti-skating is of little real consequence.

If you require an automatic turntable with effective anti-skating compensation and a cartridge tracking at, say 1 gram, to take full advantage of it, then you will have to shell out considerably more than the purchase price of the Apan.

Wow and flutter of the BFU-121 is

(Continued on page 23)

The new Apan BFU-121 has revamped styling and an improved magnetic cartridge with choice of styli.

Build your own Peerless Stereo Loudspeakers

Five pieces of chipboard and a number of lists are glued together to form a cabinet which can be later painted, veneered or simply covered with an imitation-wood paper. The cabinet is filled with sound absorbent.

Simple instructions on how to make the speaker cabinet and a description of the wiring and mounting of the speaker units are included with all Peerless Kits.

How to choose the right Peerless Kit

All Peerless Kits are of excellent Hi-Fi quality and are able to deliver more than ample output to fill the normal sized living room.
Loudspeakers and amplifiers may have different power capacities yet still work excellently together. However, due to different efficiencies within the speaker systems, the following Kits are recommended for amplifiers with at least 2×10 watts output: Kit 10-2, Kit 20-2, Kit 20-3, Kit 50-4.
The other Peerless Kits may also be used with advantage with lower powered amplifiers.

If you want a greater bass reproduction

you ought to know that the Kits containing woofers with rubber roll surround (kits 10-2, 20-2, 20-3 and 50-4) give a cleaner and greater bass reproduction, require smaller cabinets but have at the same time, a lower efficiency than the corresponding Kits with woofers with special impregnated paper surround (kits 2-8, 3-15 and 3-25). In each of the two categories you get a better bass reproduction the bigger the recommended cabinet is. Cabinet drawings included give the optimum size for the woofers involved.

If you like mid-range

you ought to know that you get a cleaner reproduction, better sound distribution and a slight boost (so-called presence effect) in this range when you choose a Kit with separate mid-range speaker (Kits 3-15, 3-25 and 20-3). For Kit 50-4, a neutral reproduction has been aimed at (ie: without presence effect).

Peerless world-famous tweeters

are included in all Peerless Kits. This means that you get distortion-free reproduction and good sound dispersal, no matter which Peerless Kit you choose.

Further information from . . .

Victoria — Danish Hi Fi. Western Australia — Danish Hi Fi.
Queensland — Brisbane Agencies. N.S.W. — Convoy.

JVC 5515X AM/FM stereo receiver

Now that FM broadcasts are a reality, it seems likely that most new hifi systems purchased will have a receiver instead of an amplifier. And for those in the market for a receiver, the JVC 5515X is an attractive unit.

Styling of the JVC 5515X follows currently popular lines with satin-finished aluminium diecast control panel and "blackout" dial. Dimensions are 452 x 155 x 324mm (W x H x D) and weight is 9kg.

When the unit is turned on, the dial scale is illuminated as shown in the photograph. Two tuning metres are provided, one for signal strength which is used when tuning both the FM and AM scales, and a centre reading metre for correct tuning indication for FM. The dial pointer is illuminated with red light and the words "FM stereo" light up in red on the dial when a stereo broadcast is being received.

On the lower section of the control panel are four large knobs and one small knob.The four large knobs are, from left to right: Speaker Selector, Bass, Treble, Source Selector and Volume while the small knob is the gain control for the microphone input socket immediately below it. No Balance control is provided. Instead, the Volume control knob has two halves which are clutched together to provide single control operation.

In our opinion, a microphone input on a stereo amplifier or receiver is something of a gimmick and we would prefer to see a separate balance control provided instead.

A questionable feature of the volume control are the click stops which provide 20 steps for the full range. At about the 10 o'clock setting, the volume control increments are about 2 to 3dB which is about optimum but at lower settings the increments are much larger. Below the 7 o'clock setting they represent more than 15dB and it is quite difficult to set the control between click positions.

So while click stops for the volume control might appear to be a refinement, they do turn out to be inconvenient when listening at low levels is required.

Inside, most of the circuitry is arranged on four large PC boards with quite a surprising amount of hookup wiring in between. There is plenty of space inside the chassis so access to the PC boards is quite good but some of the boards themselves are very crowded which can make repairs fiddly. On the plus side, the PC boards are screen-printed on both sides to make the circuitry easier to follow.

Balanced supply rails are used for the power amplifiers so that the output signal is direct-coupled to the loudspeakers. Overload protection is by way of fuses in the supply rails.

Output stages of the power amplifiers are fully complementary and diodes are used for stabilisation of the quiescent current. Tone controls use passive circuitry following a two-transistor voltage amplifier stage. This approach or variations of it are fairly common in Japanese amplifiers but it is difficult to see any advantages over the negative-feedback controls.

In other respects, the amplifier and preamplifier circuitry seems quite conventional. We did note, however, that the designers have taken a lot of care to minimise RF breakthrough.

As is usual with FM-AM receivers, the FM tuner has an attractive specification which in practice provides very good performance while the AM tuner is lamentably modest by comparison. Hifi buyers are being short-changed here, because if the same amount of design was put into the AM tuner as is shown in the FM tuner, the results would be more clearly comparable, at least as far as bandwidth and distortion is concerned.

(See article on this subject in the Hifi News column in next month's issue.)

A ferrite rod antenna for AM reception is provided within the confines of the chassis, so it is not prone to damage as could be the rear-mounted rod antennas on some receivers.

An internal FM antenna is provided as well as the connections for an external 300 ohm antenna. The internal antenna circuit takes the form of a high-voltage 100pF capacitor from the mains active lead to one side of the 300 ohm antenna input, ie, the mains wiring is used as the antenna. This will probably be quite adequate in strong signal areas but many listeners will still require a well-designed external antenna.

A label states that the 5515X is "4-channel adaptable". All this really amounts to is a set of sockets on the rear panel which enable an external matrix decoder and rear channel amplifier to be connected if desired. An output socket is also provided for the FM detector signal which could be fed to a four-channel broadcast decoder or Dolby adaptor which may be used at some time in the future.

Rated power is 19.5 watts RMS into 8 ohm loads with both channels driven simultaneously and rated harmonic distortion is 0.8%. Frequency response is quoted at 15Hz to 50kHz within ±1dB.

We measured power output at 25 watts RMS into 8-ohm loads with both channels driven; 15 watts per channel into 15-ohm loads with both channels driven and 30 watts per channel into 4-ohm loads.

Harmonic distortion was 0.15% at 1kHz at 25 watts into 8-ohm loads and was typically less than 0.3% throughout the whole audio range at up to maximum power. Frequency response at 1 watt was 15 Hz to 65kHz with ±1dB.

Phono sensitivity was 2.7mV at 1kHz for rated power and overload capability at the same frequency was 120mV which is more than adequate. Signal-to-noise ratio with a typical cartridge connected was minus 73dB with respect to a 10mV input at 1kHz.

In normal use, the performance is eminently satisfactory with no vices at all. Apart from the quibbles above, the features of the JVC 5515X are probably close to ideal as far as most high fidelity enthusiasts are concerned.

Recommended retail price for the JVC 5515X is $369.00 including sales tax. Further information can be obtained from high fidelity retailers or from the Australian distributors for JVC equipment, Haco Distributing Agencies Pty Ltd, 57 Anzac Parade, Kensington, NSW 2033. (L.D.S.)

Audiosound 75 ohm FM Aerial

While many people in Sydney are already enjoying the programs radiated by 2MBS-FM, there are a large proportion who need a better signal for improved reception. For those people, here is the Audiosound FM aerial.

FM listeners often do not realise that there are many listening situations, even in strong signal areas close to the transmitter, where an aerial system better than a simple dipole is required for satisfactory reception of stereo programs. While a weak signal will merely result in noisy stereo reception or perhaps no stereo operation at all, a strong signal with multiple echoes or "ghosts" can result in unpleasant distortion. This is known as "Multipath reception".

Minimising multipath reception is achieved by using an aerial with a strong front directional pattern to minimise interference from the sides and rear.

Another fact which may not be common knowledge amongst FM listeners is that 2MBS-FM has a vertically polarised signal rather than the horizontal polarisation used by most television transmitters in Australia. This means that those listeners using pickup from a TV aerial via a "splitter" circuit will not be obtaining optimum results. A "vertically polarised" aerial is necessary.

The Audiosound A975 FM aerial meets the above two criteria of mimimising multipath reception and vertical polarisation. In addition, it has approximately 9dB gain at 92MHz (2MBS-FM broadcasts on 92.8MHz). We assume this figure is in comparison with a dipole cut for the same frequency.

Impedance of the A975 aerial is 75 ohms which means it should be connected to the tuner via good quality 75 ohm coaxial cable. Many tuners have 75 ohm aerial input connections so with these units there will be no problems. With tuners having 300 balanced inputs, a balun will need to be used to make the aerial connection or as Audiosound suggest, simply connect the aerial directly to the inputs.

A wooden pole is supplied for mast mounting of the aerial. This is necessary for a vertically polarised aerial. If a metal pole were used, the top few feet would become a "spurious" element of the aerial and more than likely degrade its performance. If mounted outdoors, the wooden pole will require several coats of paint to weatherproof it.

As supplied, the aerial is packed in a long carton with instructions enclosed. In its fully collapsed form it may be simply carried to the installation site and then folded out—each element has a snap fitting which holds it in place. Two U-brackets are supplied for mounting the pole to a strong support if required.

We have used the Audiosound A975 aerial in our workshop and can confirm that it has good signal pick-up and a strong directional pattern as claimed. In addition, one of our staff members has installed an A975 at his home in Sydney's far northern suburbs and he was able to obtain much improved stereo reception.

In summary, it would seem that Audiosound have made available the right product at the right time. Price for the complete aerial is $27.00.

Further enquiries should be made to Audiosound Electronic Services, 148 Pitt Road, North Curl Curl, NSW 2099.

APAN TURNTABLE

quoted at 0.1% RMS. We measured it at 0.15% according to the DIN 45507 specification. This takes into account peak deviation of speed and as such is a good result for a belt-driven turntable.

The new magnetic cartridge fitted to the Apan series 4000 is a Jelco MC-14D which is normally fitted with a 0.5mil diamond stylus. If desired the stylus may be replaced with a 0.3 x 0.8mil elliptical which upgrades the performance slightly.

If the turntable is required to play CD-4 discs, the cartridge may be further upgraded by changing over to the Ichikawa stylus, which besides having contours similar to the Shibata stylus has increased compliance to enable tracking of the high frequency modulation. At the same time, the pick-up leads must be changed to low-capacitance cable. The supplier can provide the turntable ready for CD-4 operation or it can be changed over by the user at a later stage.

The improved cartridge has considerably upgraded specifications to that supplied in the previous model. Frequency response is quoted at 10Hz to 27kHz while channel separation and balance at 1kHz are 26dB and 0.7dB respectively. Recommended tracking weight is 1.5 to 3 grams.

Using the CBS STR-100 test record and a 47k load, the measured frequency response was within plus 3dB and minus 4dB from 20Hz to 20kHz. Channel balance was very good and was better than 1dB even up to 20kHz. Channel separation was better than 20dB over most of the range. Waveform of the cartridge was good, about average for a typical magnetic cartridge and had the more-or-less usual tendency for the sine waveform to become a sawtooth at high frequencies.

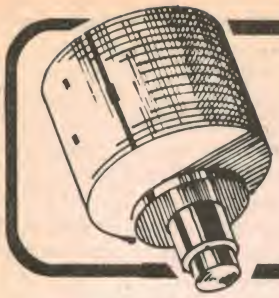
Tracking performance of the cartridge was checked using the W & G 25/2434 test record. At 2½ grams it tracked the plus 12dB test track and slightly mistracked the plus 16dB track. Increasing the tracking weight to 3 grams improved the performance slightly but our impression was that the best compromise is obtained at 2½ grams.

Sound quality of the cartridge is bright and well-balanced and will suit the requirements of most listeners. And as noted above, it can be easily upgraded by changing over to the elliptical stylus.

We still have our common complaint that the turntable is not fitted with approved three-core mains cord and three-pin plug. We recognise that the American 2-pin plugs are compatible with many imported amplifiers but remark that 2-pin plugs definitely present an electric shock hazard. Since the distributor has not been able to have the manufacturer fit the approved mains cord and plug, the user should do this.

To sum up, the Apan BFU-121 series 4000 automatic turntable still represents good value for money. It is one of the few belt-driven automatic turntables available and it is supplied complete with base, cover and cartridge. Suggested retail price for the complete package is $149.00 including sales tax.

For further information on Apan turntables contact your hifi retailer or the Australian distributors, Ralmar Agencies Pty Ltd, 71-73 Chandos Street, St Leonards, NSW 2065. (L.D.S.)

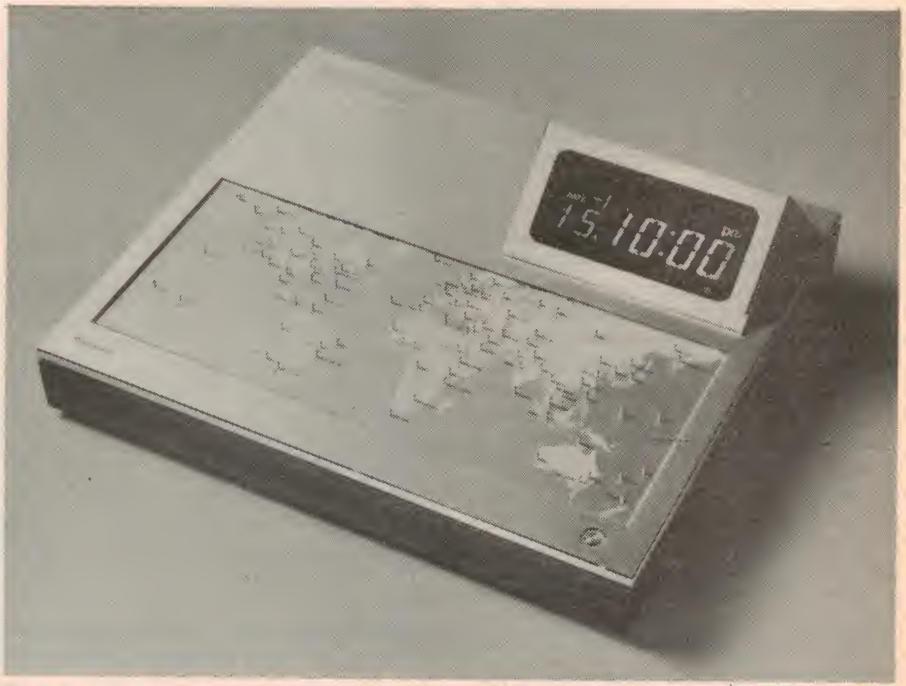


News Highlights

Advanced crystal clock tells time in 100 cities

Matsushita Electric, long active in the development of clock technology as applied to clock radios, has recently turned its attention to an entirely new field of electronic timepieces. The result is the Model RD-010 World Time-Display Unit, a fully solid-state electronic clock featuring special time-computing circuitry to enable it to instantly display the date and time for any of 100 cities in 30 different time zones throughout the world.

Main feature of the Model RD-010 is the large map of the world situated on the front panel in company with the display readout. Spread across this map are some 100 "pins," each with an accompanying LED lamp and each representing a major city. A simple finger touch on one of these pins causes the LED lamp of the selected city, and those of other cities in the same time zone, to illuminate. The date and time for the selected time zone are then displayed for about 8 seconds, after which the display reverts to local time.



Readout is via a large liquid-crystal display unit measuring 150mm wide x 90mm x 7mm thick. This indicates the time in hours and minutes according to the 12 hour system, together with AM or PM indication. In addition, the difference in date, if any, between local time and the selected time is indicated. Where appropriate, special switches can be used to display summer time (daylight saving time).

The model RD-010 is timed by a 4MHz crystal, giving the unit a claimed accuracy of plus or minus five seconds per month. In all, the various circuits employ 38 CMOS ICs, 6 PMOS ICs, 128 transistors, 146 diodes, and 100 LEDs.

Although the clock normally operates on AC, it has provision for 4 internal batteries which take over immediately if the AC power is, for any reason, disconnected. This means that the clock's precise accuracy will be maintained even in the event of a power failure, or when the unit is moved from place to place.

In order to conserve the batteries, display unit information is not shown when the unit is on battery power. The time-computing circuitry does, however, continue to function with the display unit commencing normal operation immediately AC power is restored. Operational life of the four "D" size cells is typically one year.

The Model RD-010 World Time-Display Unit is distributed in Australia by Haco Distributing Agencies Pty Ltd, 57-59 Anzac Parade, Kensington, 2033. And the cost of this undoubtedly sophisticated unit?—around the $2,500 mark!

Circular polarisation cuts ghosting effects

RCA Broadcast Systems recently showed broadcasters how circular polarization of television transmissions substantially reduces the "ghost" effect caused by reflected signals. The live demonstrations were conducted as part of RCA's extensive display of radio and television broadcast systems at the National Association of Broadcasters annual convention held last April.

Broadcasters, watching an actual transmit/receive setup in the exhibit area, were able to make comparisons between standard horizontally-polarized TV signals and those that were circularly polarized.

A low-power UHF transmitter fed two antenna systems alternately — one a standard TV transmitting type, and the second the new circularly-polarized design. The signals were simultaneously radiated by a direct path and by a reflected path to a receiver in the exhibition area. The reflected signal simulated home TV reception in areas where the TV signals bounce off neighbouring buildings, causing a secondary image in the picture.

Broadcasters attending the demonstrations observed how the use of the circularly-polarized antenna, along with a receiving antenna of similar type, substantially reduced picture ghosting. According to RCA officials, the use of matching transmitting and receiving antennas provides for "polarization discrimination", which causes a reflected signal to be rejected.

Other receivers used in the demonstration were equipped with standard horizontally-polarized antennas in order to demonstrate that existing TV receiver antennas are compatible with a circularly-polarized transmission signal.

Computerised wheelchair is voice controlled

A voice-controlled wheelchair with attached manipulator, designed specifically for paralyzed persons, has been developed by engineers at NASA's Jet Propulsion Laboratory, Pasadena, California.

Dr Ewald Heer, JPL Task Manager, said that the chair was developed from teleoperator and robot technology developed for the space program. Developmental costs of around $70,000 were shared by NASA's Technology Utilisation Office and the Veterans Administration.

Voice commands, picked up by a microphone worn by the patient, are fed to a voice-command analyser—actually a minicomputer. The analyser translates these commands into electrical impulses which activate the appropriate motors to give the desired motion of the chair or manipulator.

At its present stage of development, the analyser will accept only one-word commands. Typical commands are as follows: ready, go, stop, arm, up, down, left, right, forward and backward. These are taught to the computer by having the patient repeat them several times, thus ensuring that the system will respond only to commands given in the patient's own speech pattern.

According to Dr Heer, the system has been refined to about 97 percent efficiency, meaning that there are only three chances in a hundred of the chair and its manipulating arm failing to respond properly to a command. Further development is expected to reduce this margin of error.

Other developmental aims include expanding the system's present 32-word memory capability to incorporate a number of pre-programmed command sequences. Such sequences would enable the patient to initiate complex repetitive actions at will.

Gloomy future predicted for colour TV makers

. . . tariff levels inadequate says industry spokesman

Mr Tiki Shigemi, Australian Sales Director of MELCOA-National, manufacturers of the National range of Panacolour TV sets, recently forecast a gloomy future for Australian colour TV manufacturers. Mr Shigemi was commenting following a recent decision by the Australian Government to reduce import tariffs on colour TVs.

"The decision by the Australian Government not to give adequate protection to the Australian colour television manufacturing industry is, bluntly, a shocker," Mr Shigemi said. "The black-and-white TV manufacturing industry in Australia is dying on its feet and this latest decision means that by this time next year, the colour side of the industry will be in the same state."

"What is happening to us is an eerie parallel of what happened to the Australian car manufacturing industry last year. We shall be swamped by imports, forced to cut back local production and employment, and then, no doubt, there will be a flurry of last-minute decisions to save the industry. And this is all so unnecessary. All we require is an adequate level of protection which we know is going to last so that we can plan ahead."

"As far as our company is concerned, before the government made this decision—while we still assumed we would get an adequate level of protection—we were planning to increase production at our Penrith, NSW, plant and, of course, offer substantially enhanced employment prospects. Now, those extra jobs are out of the question."

Mr Shigemi pointed out that while there was certainly a shortage of supply in the colour TV market at the moment this was purely temporary. "Now that overseas manufacturers know that they will get a pretty free run in the Australian market they will gear up to produce sets suited to Australian conditions. And then—in about a year from now—the crunch will come for the local industry."

Mr Shigemi went on to say that Australian monochrome production was now in a state of rapid decline. He forecast that Australian monochrome production would be down to less than 20 per cent of the market demand by the end of 1975.

New Earth Resources Technology Satellite launched by NASA

A new Earth Resources Technology Satellite (ERTS) designed to help scientists study the world's crops, minerals and environment has been launched by the National Aeronautics and Space Administration from the USAP Western Test Range near Lompoc, California.

The ERTS-2 satellite was sent into a circular near-polar orbit 920 kilometres high. From here, it will circle the globe 14 times a day while its sensor systems photograph strips of the earth below to return a fresh set of photos of the entire world every 18 days.

The photographs will come from a pair of imaging systems called the Multispectral Scanner (MSS), developed by the Hughes Aircraft Company at its Santa Barbara Research Center, California, and the Return Beam Vidicon, developed by the RCA Corporation, Princeton, New Jersey.

ERTS-2 (known as ERTS-B until launch) will at first join and later replace ERTS-1, launched in 1972 with an estimated one year lifespan in space, which in 30 months of service has made nearly 13,000 picture-taking orbits while its MSS camera has returned more than 100,000 pictures of the world's land masses.

This highly-polished mirror, reflecting the face of a Hughes Aircraft Company technician, forms part of the Multispectral Scanner now in orbit aboard ERTS-2.

The Hughes MSS scanner covers an area 185 kilometres wide in four bands of the light spectrum, including the near infrared, and provides a continuous strip photograph of the earth below the satellite.

The repetitive MSS imagery has proved useful for such wide-ranging practical applications as monitoring urban development and planning future land use; identifying crops and estimating acreage; mapping strip mine and forest fire scars; locating geological formations which may contain minerals and petroleum; updating maps and navigation charts; measuring snow cover and monitoring the advance of glaciers; studying flood hazards and managing water resources; spotting underground water supplies; and locating water pollution.

One of the main assignments for the new ERTS will be to provide picture data showing wheat crop acreage in North America. These images will be combined with meteorological data from weather satellites and ground stations to show the relationship between climatic patterns and crop yields over a period of time.

International interest in establishing ERTS ground stations has mounted with at least four countries—Iran, Italy, Brazil and Zaire—announcing definite plans for their own stations to monitor the satellites. Canada already has facilities to monitor the satellites.

The ERTS project is managed by NASA's Goddard Space Flight Center, Greenbelt, Maryland. Prime contractor for the satellite is the General Electric Company. —George E. Toles.

If you can't make it with our gear, you're never going to make it.

At least you know it's not the equipment's fault if you don't have to beat them off with sticks. Models illustrated are the AA930 AM/FM Tuner Amplifier, AP004 Turntable, GX600DB Dolby tapedeck, GX510D Vertical cassette deck, ASE22 stereo headphones and a pair of SW 156 Speakers. Recommended retail prices are $480.00, $294.00, $1037.00, $435.00, $29.00 and $366.00 respectively. All AKAI Hi-Fi Equipment, distributed by AKAI Australia Pty. Ltd., is covered by the Complete Protection Plan.* This means 12 months full parts and labour warranty, 12 months free insurance and a lifetime guarantee on all GX recording heads. So make sure the Complete Protection Plan warranty card is with your equipment. See your nearest AKAI Hi-Fi Professional now.

*The AKAI Complete Protection Plan warranty does *not* cover equipment purchased outside Australia.

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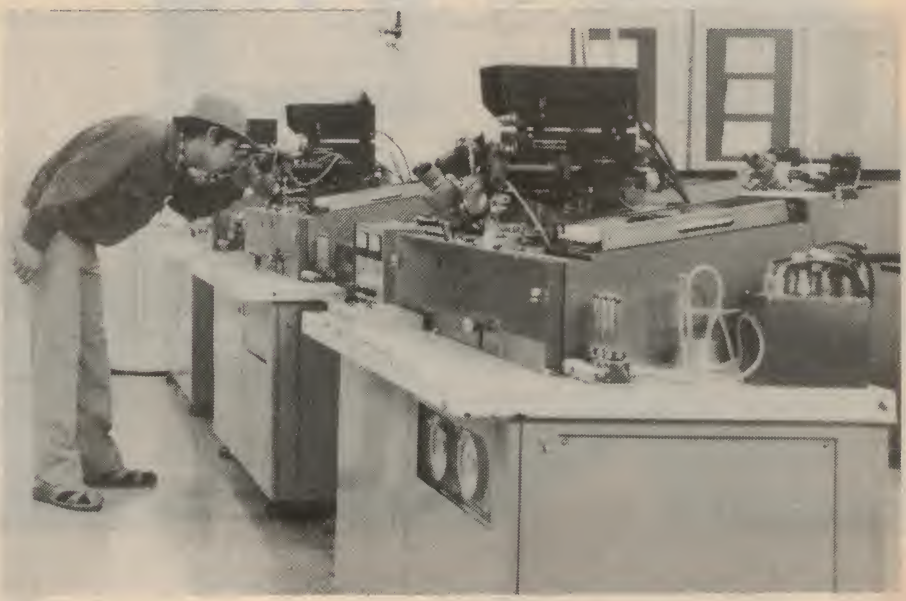
NEWS HIGHLIGHTS

Hitachi develops automated transistor assembly system

Hitachi has completed at its Central Research Laboratory in Japan a "technologically significant" transistor assembly system that can assemble a variety of types of transistors by means of pattern recognition techniques. The system has been installed at Hitachi's Takasaki Works.

The system is comprised of a minicomputer and image processors, and will ultimately have 50 wire-bonding machines with visual functions to determine chip positions of transistors fed into the machines. To recognise the position of transistor chips, an artificial eye is needed to replace the human eye. For this purpose, a microscope and a TV camera are mounted on each wire-bonding machine, so that the image signal from the camera is analysed by a combination of the image processor and the computer to yield an average high-speed position recognition of 0.2 seconds/chip.



Recognised positional data is fed back from the computer to the appropriate wire-bonding machine. This data is used to position the high-speed micro-servomechanism so the wire-bonding mechanism can stretch gold wire between the emitter and base electrodes on the chip and the corresponding outer leads. Claimed advantages of the new system include a production rate twice that of conventional methods, and the production of transistors of uniformly high quality.

According to Hitachi, its transistor assembly system is an outgrowth of studies conducted into robotics and artificial intelligence at its Central Research Laboratory. Other developments in this area include a hand-eye system that can dynamically select 3-D objects on a conveyor, defect detection devices for detecting defects in complex patterns such as printed circuit boards, and a fully automatic bolting robot for the concrete and pile industry.

Canadians complete domestic satellite system

Telsat Canada, owner and operator of the world's first domestic synchronous satellite system, recently launched its third and final spacecraft in the Anik series to complete Canada's domestic satellite communications program. Known as Anik III, the new satellite joins two sister spacecraft launched in 1972 and 1973.

The Canadian Telsat program has been designed primarily to improve radio, television and telephone links throughout the country, with particular emphasis on the remote northern areas. Each satellite in the series can accommodate up to 10 colour television channels or up to 9,600 telephone circuits. All were designed and built by the Hughes Aircraft Company, California.

Launch vehicles and facilities for the Telsat program were provided by NASA, the launch of Anik III taking place at Cape Canaveral last May. NASA is reimbursed for this support by Telsat Canada. Spacecraft command and data analysis are the responsibility of the Telsat Satellite Control Center, while tracking is provided by the Telsat Earth Station near Allan Park, Ontario. Data transmission and reception is covered by some 70 earth stations across the country.

Picture shows a new, higher powered communications satellite now undergoing development to meet specific Canadian requirements in the 1980s.

The Canadian system is now used as a guide for other countries planning similar domestic satellite communications programs. A list of these countries includes Iran, Brazil, Australia, Norway and the Arab states. Indonesia has already decided to go ahead with a system similar in design to Anik.

Italy to adopt PAL colour TV system

An Italian government technical committee has recently endorsed the West German PAL colour TV system for Italy's state-run RAI television network. The endorsement, due for ratification by the government's committee for economic planning last April, ends a five year political wrangle between proponents of the PAL system, the French SECAM system, and a never-fully-developed Italian system.

The decision to adopt the PAL system brings Italy into line with the bulk of other Western European nations. The obvious exception here is, of course, France which uses its own SECAM system. This latter system has also been adopted by the Soviet Union and other East Bloc countries.

Meanwhile, Spanish officials, under pressure from domestic set makers who see colour television as a means of revitalising a depressed industry, have announced that a decision between PAL and SECAM is near. Spain tentatively adopted the PAL system some two years ago, but postponed an official selection pending a decision by the Italians. Given the Italian move, Spanish adoption of the PAL system now seems certain.

At left, the 3M Model 526 Learning Station, a portable instruction unit equipped with its own viewing screen. Main features of the unit include the ability to re-program, instant replay, forward or reverse capability, and a pause control.

Sound-on-Slide: a new audio-visual concept

An advanced new audio-visual system has recently been released onto the Australian market by 3M Australia Pty Ltd. Designated "Sound-on-Slide," the new technique essentially combines the roles of a 35mm slide projector and a tape recorder to give "talking slides." Here we take a look at the 3M Model 625 Sound-on-Slide Projector-Recorder.

Designed to stimulate the learning process, audio-visual teaching methods have gained increasing acceptance in educational and training applications in recent years. Coupled with this increased recognition is the role advancing technology is playing in developing more effective audio-visual presentation techniques and equipment for an expanding market.

It was against this background that the Visual Products Division of 3M Australia Pty Ltd recently released its new range of "Sound-on-Slide" equipment—a unique system which uses a magnetic disc to provide audio commentary in synchronisation with 35mm slide presentation. Included in the new range is the 3M Model 625 Projector-Recorder, which incorporates full record/playback facilities.

An automatic playback unit with playback only facilities is also available. This machine is essentially the same as the Model 625 Projector-Recorder, but stripped of recording facilities. Because other facilities offered on both machines are similar, we will confine our description to the Model 625.

The Model 625 Projector-Recorder was developed in order to eliminate the synchronisation problems that can occur with "two-media" systems—that is systems which involve a 35mm slide projector coupled to a separate tape recorder. In this case, synchronisation problems are completely eliminated by using a specially developed magnetic recording disc, integrated into a plastic frame which also holds a 35mm photographic slide. Each slide is thus provided with its own recording disc, the sound commentary on which is played back automatically when the slide is projected.

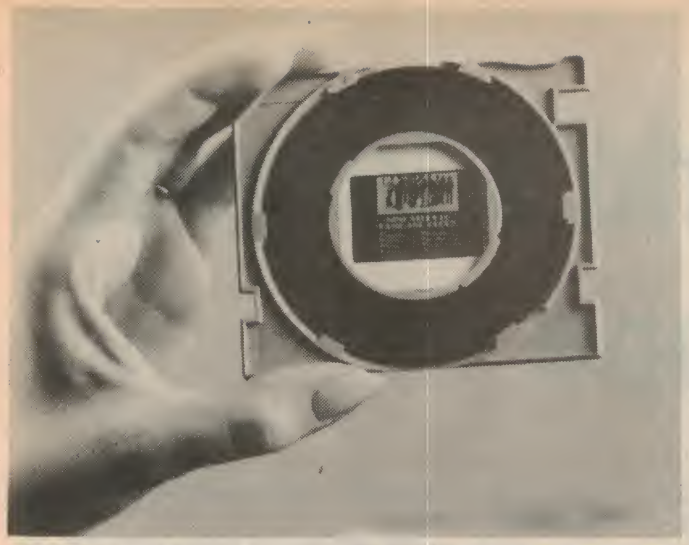
The disc itself is recorded on one side only, and is rotated by friction drive at its edge. The surface is grooved to provide a tracking guide for the record/playback head, which moves from the outside to the inside of the disc during playback and recording. Nominal recording time is 30 seconds.

This new technique provides the user with a great deal of flexibility, in that each slide is an independent self-contained unit. By eliminating conventional tape recording techniques, the user is able to rearrange the slide sequence at will, and can edit or update individual slides without affecting other portions of the program. In addition, the Sound-on-Slide technique permits complete user control over the program at any stage of the presentation.

For the student, the system offers a number of benefits. The equipment itself is easy to operate, and allows the student to move through a program at his own pace. Backward sequencing facilities are provided, as are facilities to repeat the sound track for any slide as required.

Users of the Sound-on-Slide system have noted that its ease of operation and compact design make it particularly suited to hands-on instruction. With this technique, the student can see and hear a point of instruction and can immediately perform some activity to reinforce the learning process. In other words, the system can be programmed so that each step in an instructional sequence requires student response.

The application of these features has produced noticeable improvements in the learning process in a broad range of instructional subjects. For example, educators in the vocational-technical area have remarked that the Sound-on-Slide concept has made possible a new dimension of educational effectiveness. In programs ranging from automotive repairs to medical technology, results of individualised learning programs with the 3M system have outstripped those pre-



The re-recordable magnetic audio disc shown integrated into its plastic frame. Nominal recording time is 30 seconds.

This view shows a 35mm slide being inserted into the plastic frame on the opposite side of the recording disc.

viously obtained with conventional methods of instruction.

Among the accessories available with the unit is a rear screen attachment that can convert the Sound-on-Slide unit into a self-contained learning station. Other accessories include student responders, sound replicators, earphones, and a study carrel kit, to name a few.

A choice of straight and circular trays is also available. The straight tray can accommodate up to 36 slide frames, allowing slide sequence to be easily changed and re-recorded without disrupting audio synchronisation. The circular tray allows a program to be set up for a continuous showing. It holds up to 40 slides and has the same easy slide changeability and recording facilities as the straight tray.

As mentioned above, the Sound-on-Slide equipment is simple to operate. Three modes of operation are provided: record, manual and automatic. Standard facilities provided include output jacks for external speakers and headphones, instant replay capability, a pause control (permitting the user to stop at any time during playback and recording of the commentary), and the ability to accept a range of projection lenses.

In the manual mode, the operator controls the machine through a remote control handset, normally stored in the control panel. When the forward button is pressed, the slide is raised into the play position, the head contacts the disc to begin the commentary, and the lamp lights to project the transparency. A shutter in the light path is used to reduce "ghosts" on the screen between slides.

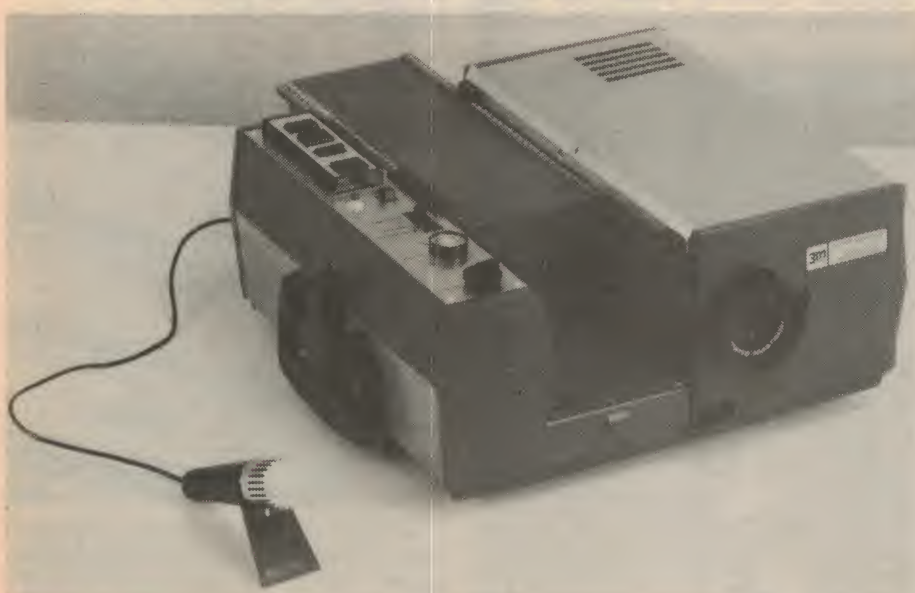
The slide remains in the projection position until the forward button is pushed again to advance the next slide. This enables the operator to add further comments after the recorded audio commentary had expired. The slide sequence is reversed simply by pushing the appropriate button.

When operated in the automatic mode, the machine has the capability for complete hands-off operation. An audio sound cue recorded onto the sound track is used to automatically advance the slide sequence. This cue is produced during the recording process and can be placed anywhere on the sound slide, giving a maximum cue time of 30 seconds. If an audio sound cue is absent, the machine requires operator cueing to advance the next slide.

Programs are recorded onto the magnetic discs using the microphone provided with the machine. The operator first of all writes and times his script, and prepares the slide transparencies. Each slide is advanced, in turn, to the projection position, and previewed by pushing the instant replay button. The instant replay button is then released to begin the recording process. To cue the slide for automatic playback, the red record signal button is pressed. Recording level is automatically controlled.

Power output from the audio amplifier built into the projector is 1.5 watts, quite sufficient for individual and small group situations. Frequency response for the Projector-Recorder is quoted at 200-4,000Hz.

In summary, the Model 625 Projector-Recorder is an advanced audio-visual concept that should find a wide range of educational and institutional applications. The concept combines extreme versatility with ease of operation and, as such, should prove a serious contender in the audio-visual field.



The 3M Model 625 Sound-on-Slide Projector-Recorder will accept either straight or circular trays of "talking slides". Intended mainly for educational purposes, this unique system was developed in order to overcome the synchronisation problems encountered when using separate recording and projection equipment.

This article is based on information supplied by 3M Australia Pty Ltd, 950 Pacific Highway, Pymble, NSW 2073. Telephone 498 0033.

Arecibo: world's largest radio telescope

The world's largest radio telescope, the US operated Arecibo Observatory in northwestern Puerto Rico, has recently undergone modification to extend its capabilities. These modifications, which included a new aluminium reflector surface and new transmitting equipment, enable Arecibo to probe to the very edge of the now observable universe.

Situated some eighteen kilometres southeast of the coastal city of Arecibo is the world's largest radio telescope, the Arecibo Observatory. This giant telescope forms part of the American National Astronomy and Ionosphere Centre, a research centre operated by Cornell University, and probes the universe through the radio part of the spectrum, transmitting as well as receiving.

The Arecibo Observatory is an impressive sight, as the accompanying photographs will testify. The reflector bowl, measuring some 305 metres in diameter, occupies a whole natural valley, surrounded by limestone mountains. Above the vast bowl, the triangular-shaped platform carrying the transmitting and receiving equipment, in all 612 tonnes, is suspended from three concrete towers which stand on the surrounding hills.

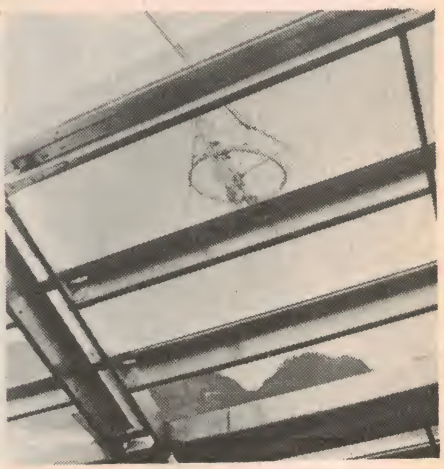
Several major improvements have been made to the Arecibo telescope in recent years. These improvements, costing over $US8 million, have seen the original wire mesh surface of the reflector bowl ripped off and replaced with some 38,778 individual aluminium panels. This modification enables the reflector bowl to reflect wavelengths shorter than those capable of being reflected by the original wire mesh covering.

One of the most dramatic improvements to the telescope has been the addition of a powerful new radar transmitter to the existing transmitting equipment. This new transmitter has an output of 450kW and, when concentrated into a narrow beam by the reflector, has an effective radiated power 100 times greater than the total electric power production of all the generating plants in the world.

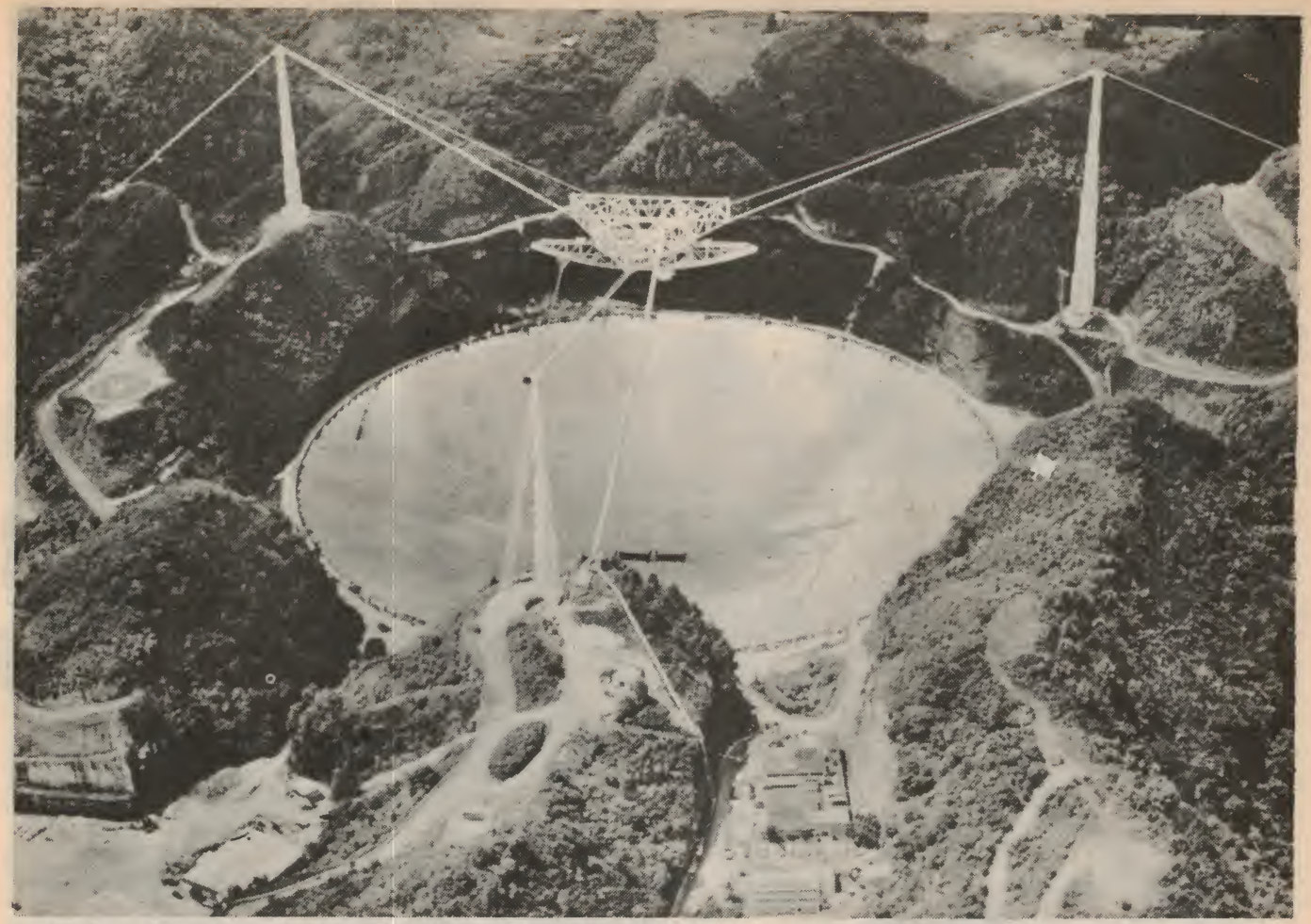
The addition of radar equipment, together with the new aluminium surface, means that the Arecibo telescope can now probe the 80km thick clouds of Venus, and return photograph-like images of the surface. The telescope can also be used to make fairly detailed radar pictures of Mercury and Mars, study the surfaces of some 50 asteroids, map the four satellites of Jupiter, and seek out new information on Saturn's rings.

The signal from the Arecibo Observatory is the strongest now leaving Earth. If, by chance, there is an instrument similar to the Arecibo telescope anywhere in the Milky Way, it should have little difficulty in locating this signal. Indeed, to the radio eyes of "creatures" on distant stars, the Arecibo telescope would gleam 10 billion times more brightly than our sun.

If there is intelligent life in space, it may well discover Earth through Arecibo. Meanwhile, Arecibo is on listening standby, waiting for that radio signal that will indicate the presence of such intelligent life.



At left, this three minute night-time exposure shows Arecibo's radio antennae platform outlined against star tracks of the Puerto Rican sky. Above view shows the new aluminium reflector panels attached to supporting frames. The panels are perforated, allowing sunlight to reach vegetation underneath the reflector bowl.



. . . searching for life in space

Above: looking rather like a frog with large feet, this worker at the Observatory is wearing rubber footpads to distribute his weight more evenly on the aluminium panels of the reflector bowl. Above, right: three senior staff members at Arecibo. They are (from left): Harold Craft Jr., Director of Observatory Operations; Frank Drake, Director of the National Astronomy and Ionosphere Centre which administers the Observatory; and Rolf Dyce, the Observatory's Associate Director. At right: workers check laser targets (white squares) on the reflector bowl. The laser, suspended above the bowl, is able to survey the entire surface in a single night with an accuracy of approximately 3mm.

Plug into the sun with a solar cell array

Once so expensive that they were used only in space satellites and other esoteric applications, silicon solar cells are now available at a cost low enough to make them attractive in boats, caravans, and for things like amateur radio repeaters. This article explains how they work, and tells how easily you can build yourself a solar power supply system.

by JAMIESON ROWE

No doubt most readers of EA will have heard of silicon solar cells by now, as they have been around for more than 20 years. Since their development by Bell Laboratories of the USA in the early 1950's, most of us have seen news stories of them being used as a power source in space satellites, remote repeater stations and similar esoteric applications.

By and large, however, they have been a pretty expensive way of generating power—at least as far as you and I are concerned. Not in terms of running cost, because sunlight comes cheaply, but in terms of initial cost. Until now, you've had to pay upwards of $300 per "peak watt" of power, where a peak watt is one watt generated under ideal conditions.

Happily, this situation has started to change, and for the better. Just recently, new manufacturing techniques have been evolved, and these have resulted in cell prices falling to the point where you can now generate solar power for around $30 per peak watt—much lower than the previous figure.

Of course, this still isn't peanuts. It doesn't compare with the price you pay for normal 240V mains power. But considering that running costs are virtually zero, it means that solar power is now well worth considering for things like maintaining batteries on boats and caravans, standby power for your home, and powering amateur radio rigs like repeater stations.

The new lower-cost solar cells are available now, right here in Australia,

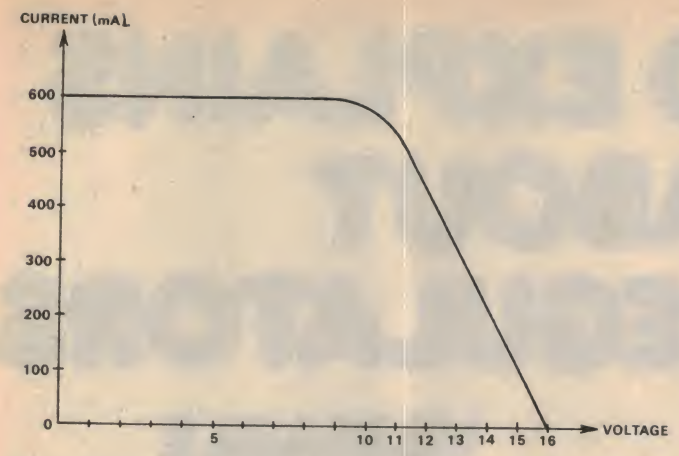


Fig. 1: The output voltage-current characteristic of the SPC-1002 array for a fairly clear day. For a dull day, the current plateau may be around 100-120mA.

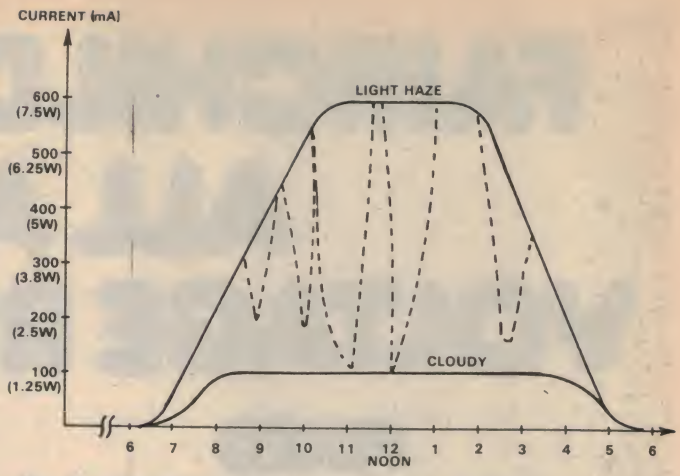


Fig. 2: How the output tends to vary during the day, and from day to day. The dashed curve is for a cloudy day, with alternate periods of unobstructed sunshine and overcast.

from Joseph Lucas (Australia) Pty Ltd, a firm well known in the automotive electrical field. Recently it concluded a marketing agreement with the Solar Power Corporation of Braintree, Massachusetts, USA, to handle that company's range of solar cells and arrays.

For EA readers, probably the most interesting product in the SPC range is the SPC-1002 solar cell module. This consists of five solar cell wafers, each 55mm in diameter, wired in series on a sturdy fibreglass PC board. The assembly is mounted in an impact resistant clear polycarbonate case, and hermetically sealed with silicone rubber. The external dimensions of the complete module are 346 x 74 x 8mm, not counting the two connection terminals at the rear.

Under typical peak solar illumination the SPC-1002 module generates about 1.2 watts of power – 600mA at 2V. Thus an array of six modules will produce a healthy 7.2 watts, or 600mA at 12V. And the characteristics of the modules are such that such an array is most ideal for charging a 12V lead-acid accumulator; it has almost constant-current characteristics when the battery is discharged, yet reduces the charging current automatically when the battery reaches full charge.

The cost of a set of six SPC-1002 modules is $219.00 plus tax (15%). You can buy them alternatively mounted in a special ruggedised frame, for marine use, but this ups the cost to $276.00 plus tax. We suggest that you use the separate modules, and make your own frame up as shown in the photographs. The frame pictured cost us less than $3, for three strips of aluminium "L" extrusion, and took only a couple of hours to put together.

The sort of performance you can expect from such an array is shown by the diagrams of Figs 1 and 2. These show the output from our array—with a series silicon diode—both as a function of loading, under peak conditions, and as a function of time during the day. Incidentally the reason for the series silicon diode is that this is necessary to prevent the battery discharging back through the array, when the latter's output falls (i.e., at night).

You can see from Fig 1 that the output voltage of the array is fairly constant with illumination. What does vary is the maximum output current, which is proportional to illumination, and virtually constant for a given level of illumination. Note that even on a relatively dull day, the maximum output current may be in the order of 100-120mA.

The way the output of the array tends to vary during the day is shown in Fig 2. This was plotted from the behaviour of our unit over a number of days in late April, in a typical Sydney location. The curve shows the output on a typical clear day, on a relatively dull day, and on a day with varying cloudy-clear conditions.

As you can see, the output from the unit on a clear day can be around 4 ampere-hours total—arrived at by adding up the total area under the curve. For a week of clear days, therefore the total energy produced may be as much as 28 ampere-hours.

Incidentally, this is with the array fixed, tilted at the optimum angle of inclination for the location concerned (more about this later), and aimed due North. More energy could be produced by having the array "follow the sun" like a sunflower, but this would involve some sort of servo system, and the additional complexity would probably not be justified.

While these curves represent Sydney in autumn, they are probably fairly typical of what may be expected in most other locations even in summer. This is because the efficiency of solar cells tends to be inversely proportional to temperature. As the array gets hotter, its output tends to fall. Hence the performance

At right is a close-up of our experimental array, shown also at the top of the facing page during assembly by the author. The frame was built up from low cost aluminium angle.

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tends to be optimum on cool clear days, rather than on hot glaring days.

You can see from the curves that with a peak output of around 25-28 ampere-hours per week, the array of six SPC-1002 modules can provide a very useful amount of energy.

If you're a boat owner, it would of course be ideal for keeping the boat battery fully charged. Similarly it can do the same job with a caravan battery. Or you can use it in the home, to maintain a battery for running emergency lighting, radios, and TV sets during power blackouts.

And of course these aren't the only applications. If you're a radio amateur living in the country, you could use the array to power your rig, as many modern transmitters and receivers will work from 12V DC. Even if you don't live in the country, the current emphasis on ecology, energy conservation and avoiding pollution may still make the idea attractive. Think about being able to tell your contact that "the rig here runs from solar power!"

Another application you could consider is powering your home burglar alarm system. In conjunction with a small storage battery, the solar array would be ideal for this sort of job. You'll no doubt be able to think of many other applications as well.

Now for a few practical details. Although the solar array is capable of running loads up to 7 watts or so directly, during peak daylight hours, in most cases you'll want to use a lead-acid battery to store the energy and tide you over dull days, nights, etc. The circuit needed is quite straightforward, and is shown in Fig. 3.

The meters shown are optional, and needn't be used if you don't want to. The 1A ammeter is for keeping an eye on the charging current delivered to the battery by the solar cell array, while the voltmeter is for monitoring the battery condition. The simple resistor/zener diode string in series with the voltmeter is to make it a suppressed-zero type, so that it reads from about 10-15V. This expands the important part of the scale, and allows more accurate and convenient reading.

Note that the voltmeter is actually a standard 0-1mA movement, which you'll have to calibrate 10-15V using another meter as a comparison. We can't give you the scale, as the exact calibration will depend upon the zener diode.

Diode D1 is to prevent the battery from discharging back through the solar array, as mentioned earlier. It should ideally be a high current silicon power diode—not because the current is high, but because this type of diode will have the lowest voltage drop. You could alternatively use a germanium power diode, or the collector-base junction from an old germanium power transistor, if you have one, as this will give an even lower voltage drop.

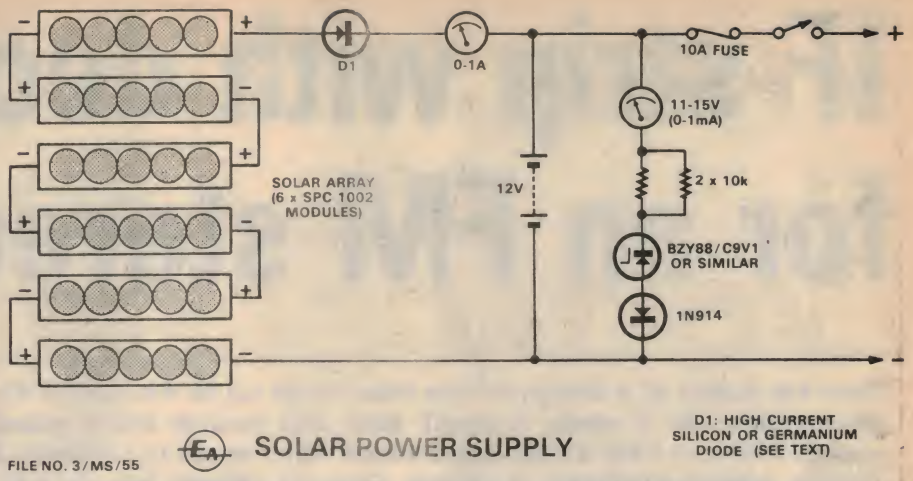


Fig. 3: Suggested circuit for a solar power supply using SPC-1002 modules.

Note, however, that the solar array is in fact intended to have a silicon diode in series, so that its output voltage is high enough to raise a 12V lead-acid battery to full charge allowing for the 0.6V drop. The main thing is not to use a very small diode whose drop may be somewhat larger than this. We used one of the 25A devices, as used in auto alternators.

At this stage you're probably wondering what size battery should be used. Strictly this will depend upon the loading you are going to give it, and the type of service. If you will be using light loads like a radio receiver, but frequently, there would be little point in using a battery of more than about 20 ampere-hours capacity. On the other hand if you are likely to want to draw quite heavy currents, but only infrequently, it could be worth going to a larger unit—say up to 90 ampere hours.

We compromised with the unit pictured, using a battery of the size used in many modern cars—around 45 ampere-hours capacity. This seems a good compromise between the ability to deliver useful current into short-term loads, and the time taken for the solar array to bring it back to full charge.

If you're going to use the solar array on a boat or caravan, it won't be feasible to tilt it up at the optimum angle for solar illumination. In this case, the best idea is to mount it horizontally, on the cabin or caravan roof. But in a fixed situation such as a home or amateur "shack", a worthwhile improvement in output can be achieved by tilting and correct orientation.

As the pictures show, we built up a rame for the solar modules from light aluminium "L" extrusion. The extrusion we used measures 16 x 16mm in cross-section, with a thickness of about 2mm.

The simple rectangular frame on which the modules are mounted measures 350 x 450mm. This is tilted in our case at an angle of 41° to the lower rectangular frame, which mounts on the roof. The angle was arrived at by taking the optimum angle of inclination for Sydney, which is 39°, and adding 2° to allow for the roof slope.

OPTIMUM INCLINATION FOR SOLAR ARRAYS

Darwin	17°
Cairns, Broome	22°
Rockhampton, Alice Springs	28°
Brisbane, Geraldton, Broken Hill, Perth	37°
Sydney	39°
Canberra, Adelaide	40°
Melbourne	43°
Hobart	48°

In our case the lower frame worked out to be 454 x 464mm, with the tilting members 314mm long. This is with the tilting members at right angles to the sloping array frame, giving a sturdy construction. We bent up the frames by cutting out "V" pieces at the corners, and bending them with heavy pliers. The joins were reinforced with small lengths of the same extrusion, and fastened using 3/16in brass machine screws and nuts. You could alternatively use pop rivets.

The exact dimensions of your lower frame and tilting members will depend, of course, on your location and the slope of the roof on which array is to be mounted. The optimum angles for inclination in the various main cities are shown in the table, to help you in working this out. Don't forget that this is the angle to the horizontal, so that you'll have to allow for the roof slope. If you're very lucky, you might even have a roof of the correct slope.

You should ideally aim the array in the direction of due North, to get optimum coverage throughout the year. This needn't be highly accurate, as a few degrees either way probably won't make all that much difference, but try to aim it as near to North as you can. Don't forget that true North is not quite the same as magnetic North.

SPC solar cells and modules are available from Joseph Lucas (Australia) Pty Ltd, 1156 Nepean Hwy, Cheltenham, Vic. 3192.

IF strip with decoder for an FM stereo tuner

Here are details of a design for the heart of an up to the minute FM stereo tuner. All it needs is an RF front end module and a power supply, and you have a high performance tuner equal to commercial models costing hundreds of dollars. Features offered include AFC, delayed front end AGC, off-station muting, tuning meters and active filtering of the stereo outputs.

by IAN POGSON

Now that FM stereo broadcasting is finally getting off the ground in Australia, no doubt many music lovers and hi-fi enthusiasts are giving serious thought to acquiring an FM tuner-decoder. There are of course the two alternatives—should you buy one, or build one?

There are a number of simpler tuners around, most of them imported, and attractively priced. If you're not too critical, one of these might well prove the best proposition. But if you want to go a little further, and appreciate a few refinements, you'll find yourself looking at commercial tuners costing hundreds of dollars. Here's where you can make a worthwhile saving, by building up a higher-grade tuner yourself.

With this in mind, we have spent the last couple of months developing a new FM-stereo tuner which we believe will meet just about everyone's requirements. It uses the latest ICs and state-of-the-art circuit techniques, and will provide virtually all of the performance features of the more expensive commercial tuners.

The new tuner includes a MOSFET front end, 10.7MHz IF amplifier gain block, a limiter and detector with many peripheral facilities such as AFC, AGC and muting, a stereo decoder and finally active filters in each stereo output. The circuit development of the design is now complete, and work is proceeding on the mechanical presentation—front panel, cabinet, etc, so that it may reasonably compete with commercially available units with respect to aesthetics. The complete unit when finished will incorporate all the above, together with a good quality AM tuner and built in power supply.

So that the more experienced readers will have some information to get their teeth into, we have decided to start the ball rolling a little earlier than otherwise by describing here the heart of the tuner—the FM IF strip, detector and stereo decoder section. This is virtually the whole of the tuner except the RF front end and the power supply. These will be described later.

Incidentally, there are a number of tuner front ends available commercially, which could be used with the circuit described here if you wish.

Let us have a look at the circuit and see just what is involved. It starts immediately after the output of the mixer which is included in the front end. One requirement for any front end feeding into this circuit is that it have a source resistance of 330 ohms, to match into the first element of our circuit: a Murata 10.7MHz ceramic filter.

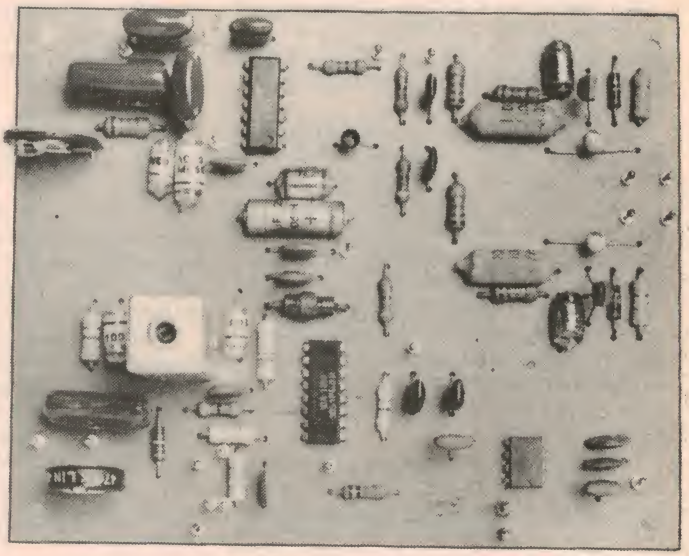
Following the first ceramic filter is a "gain block" using an IC type ULN2208 or ULN2209, which amplifies the 10.7MHz IF. The difference between the two device types is one of gain: the former has a gain of 34dB and the latter 48dB. The input and output resistances are 330 ohms, which satisfies the ceramic filters before and after it.

The second ceramic filter feeds the multiple-function IC, type TDA1200 or CA3089E. This IC performs the main functions of IF amplifier, limiter and quadrature detector. In addition, provision is made for interchannel controlled muting, AFC and delayed AGC for the front end, switching of some types of stereo decoder, drive for a tuning meter and drive for a field strength meter. Quite a list of features for one IC chip!

In addition to all that, there is an option on the quadrature coil arrangement. With a single tuned coil, the distortion is quoted as 0.5%—quite a low figure. However, if a double tuned coil is used, it is possible to get the distortion down to about 0.1%.

In addition to provision for muting, we have added switching so that the muting facility may be left in circuit or disabled when required. For tuning purposes, it may also be desirable to disable the AFC circuit, and this is provided for.

The composite audio signal from pin 6 passes through a low pass filter to pin 2 of the stereo decoder. We have used the type MC1310P, or XR1310P and we have found it to be simple to get going and very satisfactory in every way. Only one adjustment is necessary, which is the oscillator frequency, easily set up with the 4.7k potentiometer. The stereo switching function is brought into operation automatically when a sufficiently



At right is the completed IF strip with stereo decoder assembled onto a small PC board. Circuit board pins have been used to facilitate external wiring connections.

strong signal is forthcoming from the detector and an indicator lamp is switched on at the same time. Provision is also made to switch to mono operation manually if the listener wishes.

Readers who may be interested in further information on this device are referred to the article by Jamieson Rowe, in April, 1975.

Left and right channel audio components emerge from pins 4 and 5 respectively, each with a de-emphasis filter. Even after this filter, there is still quite a substantial amount of 38kHz switching component left. While for normal listening this generally presents no problem, it can be embarrassing if one wishes to tape record some of the program material. The 38kHz component may interact with the bias oscillator in the recorder, with consequent undesirable whistle effects. To overcome this problem, each channel is passed through an active filter, consisting of a bipolar transistor and LC network.

So much for the basic circuit elements. Before proceeding with a consideration of components and construction, we will consider a number of options which may be included or otherwise.

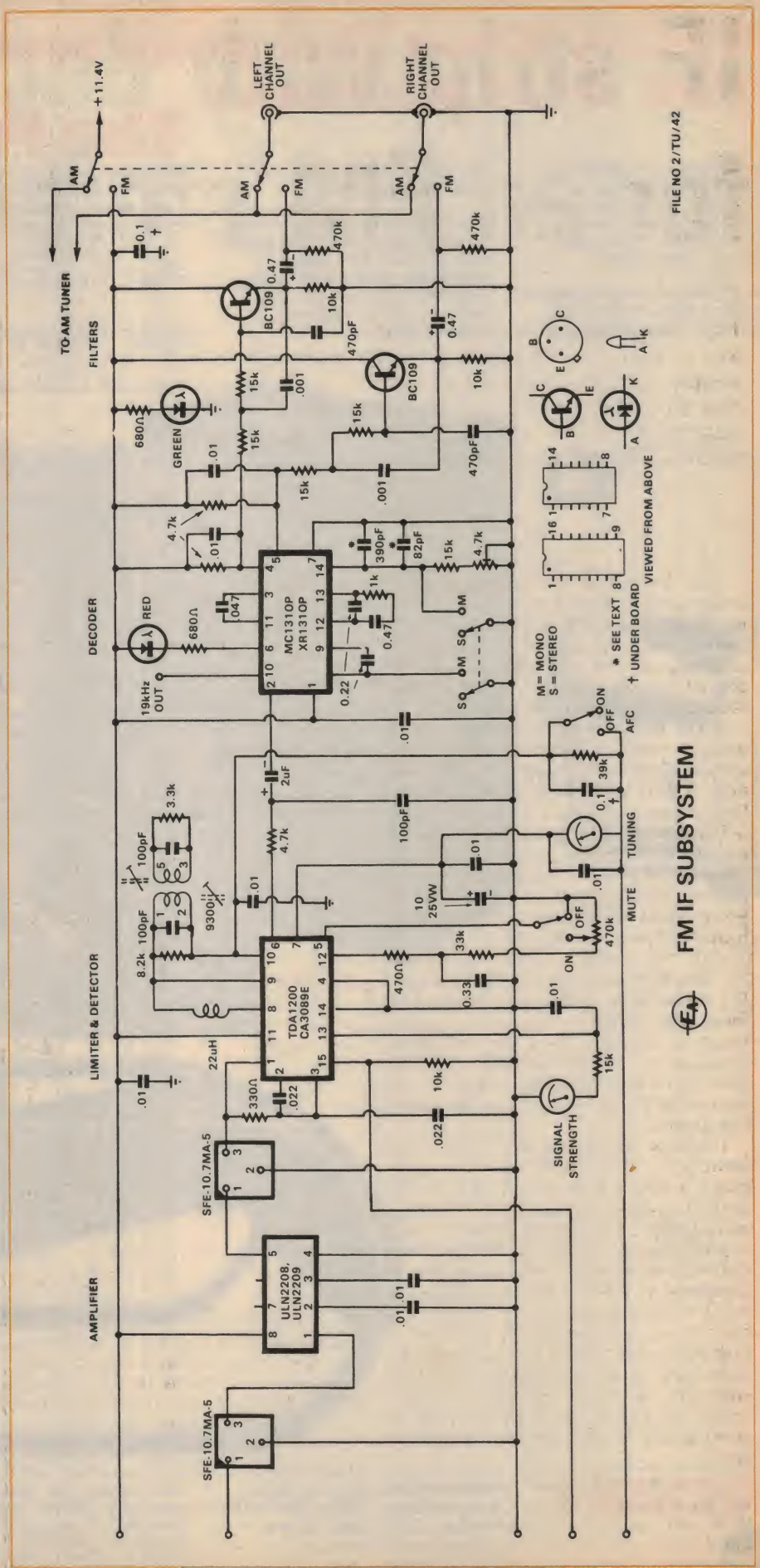
Some options may depend more on other conditions, rather than those just mentioned. For example, the "gain block" amplifier near the input may not be required if the signals you wish to receive are so strong that the main IF chip limits adequately.

A variant on this may be that although an amplifier may be necessary or desirable, the question may arise as to which one to use. If the maximum gain is required, then the ULN2209 with a gain of about 48dB should be used. On the other hand, if less gain will suffice, then the ULN2208 with a gain of about 34dB is the one to use.

Of the options provided by the limiter-detector IC, possibly the one which may most easily be dispensed with is the field strength meter, although this is a useful luxury. If you do not wish to fit this meter, then all components from pin 13 may be omitted.

It is also possible to dispense with the tuning meter, but we suggest that unless you have good reason for doing so, it is wise to fit this facility. With it you can tune accurately to the wanted signal and ensure low distortion. If you do elect to omit this meter, then its terminal points should be shorted.

The next option is quite an interesting one and this concerns the quadrature coil. If you elect to wind the coil yourself and you do not feel up to tackling the double wound coil with the required accuracy of construction, then the single coil is for you. On the other hand, we



At right is the circuit diagram for the FM IF strip with stereo decoder. Main features include the provision of AFC, AGC and muting, and active filters in each stereo output.

Plessey show that great sounds can come from small packages

The PE800

An addition to the PE series – the PE800 is superbly engineered for enthusiasts who want quality performance without sacrificing too much valuable living space.

The PE800 provides impressive overall response with a high performance low compliance 8-inch driver and two 3-inch curvilinear tweeters.

Cabinets are beautifully finished in hand-rubbed American walnut woodgrain and the easily removable open cell polyurethane foam grille brings good looks as well as acoustic transparency.

PE800's are supplied as matched pairs and carry a five-year guarantee. Also in the series is the PE1000, an acoustically tuned 3-way three speaker system.

	Frequency Response	Power Handling	Dimensions
PE800	45 Hz to 20 kHz	20w RMS 40w Programme	555 mm h 370 mm w 240 mm d
PE1000	40 Hz to 30 kHz	20w RMS 40w Programme	597 mm h 390 mm w 299 mm d

PLESSEY

Further information is available from the listed outlets or direct from:
Plessey Australia Pty. Limited,
Components Division,
The Boulevard,
Richmond, Vic. 3121

Available now from: NSW – Lawrence and Hanson Pty. Ltd., Martin De Launay Pty. Ltd., Dick Smith Wholesale Pty. Ltd., Haberecht's Radio & TV Services. VIC – Lawrence and Hanson Pty. Ltd., Radio Parts Pty. Ltd., Fidelity Hi Fi, McGrath Radio. QLD – The Lawrence and Hanson Electrical Co. (Qld.) Ltd., L. E. Boughen & Co. SA – Gerard & Goodman Pty. Ltd., K. D. Fisher and Co. WA – Atkins Carlyle Ltd., H. J. McQuillan Pty. Ltd. TAS – Quantum, W. & G. Genders Pty. Ltd. CANBERRA – Allied Hi-Fi.

AR72

understand that at least one manufacturer is going to wind these coils and for the extra cost involved, you may indulge in this refinement.

The next option is a major one: the stereo decoder. If you want to save money, and will be content with mono, the decoder may be dispensed with, and the two filters following it may also be omitted. With these items left out, it will be necessary to include a de-emphasis filter at pin 6 of the TDA1200. All you have to do is to change the 100pF capacitor to .01uF. The 2uF coupling capacitor may be changed to 0.47uF and terminated in 470k. This will become the audio output point.

Assuming that you are using the stereo decoder, it is possible to do without the two output filters, provided that you do not intend to do any tape recording. At the same time, even though you may not have any ideas of taping programs, we feel that it would be wise to include the filters as a matter of course.

Having had a general look at the unit, some comments on components may be helpful. The circuit under discussion is accommodated on a printed circuit board 102mm x 127mm (4in x 5in). This board will be available from R.C.S. Radio, and no doubt other manufacturers, and may be obtained from your usual supplier.

IF selectivity is obtained with two Murata SFE-10.7MA5 ceramic filters. These are readily available, being imported by IRH Components Pty Ltd. However, there is one important point which should be observed when purchasing these filters. Due to spreads in production, they do not all come out at exactly 10.7MHz. Production is sorted and colour coded according to the centre frequency, so that the important thing is to use two units with the same colour code. Thus if you use white coded filters, for example, the centre frequency will be 10.76MHz.

The gain block ICs type ULN2208 and ULN2209 are made by Signetics and imported by Tecnico Electronics. By the time this appears in print, stocks of these devices should be available through the usual suppliers. We have tried both types and while both do the job, the one with the higher gain introduces a problem in our overall setup, in that there is too much gain and this inhibits the operation of the muting facility. In short, the mute circuit remains open at all times, regardless of the adjustment setting.

So that both types of IC could be tried, we provided a socket in this position on the board. However, unless you have a particular reason for wanting to use the higher gain version, we advise that you stick to the one with the lower gain (ULN2208), which should be adequate for most purposes.

The next IC is the IF subsystem, identified by two type numbers TDA1200 and CA3089E. The former comes under the brand SGS and the latter the familiar RCA. Warburton Franki are the importers of SGS devices while AWV are the importers of RCA. Both types are interchangeable and there seems to be little to choose between them.

Coming to the stereo decoder IC, type MC1310P is marketed by Motorola and Signetics and the XR1310P is marketed by Exar Integrated Systems. Local distributors for Motorola, Signetics and Exar are Total Electronics, Tecnico Electronics and A. J. Ferguson Pty Ltd, respectively.

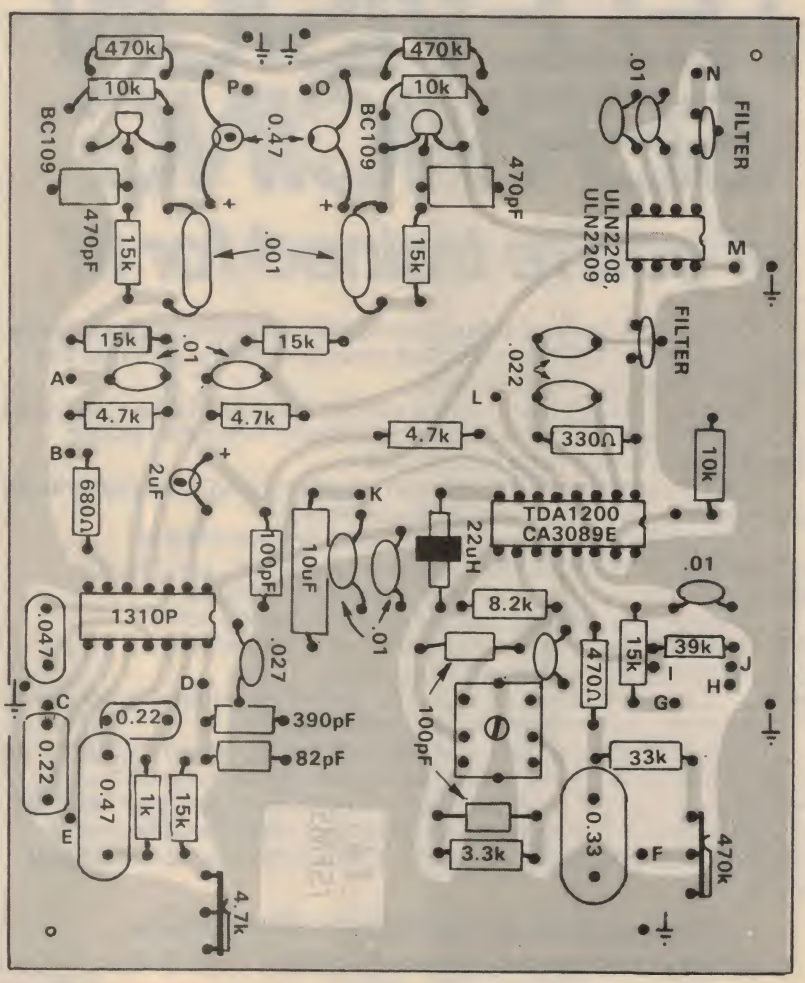
There are only two transistors used on this board and as they are working at a relatively low level we have specified the low noise type BC109. It would be wise to stick with these or a similar type.

The quadrature detector coil has already been mentioned with regard to possible options. Readers may obtain the necessary components and wind their own, either single or double winding and more will be said about this later on. However, if you do not want to go to the trouble of winding your own coil, then Transcap Pty Ltd have wound one with both windings under type 9300. These coils are distributed by Watkin Wynne and should be available from the usual components sources.

The two meters are imported by University Graham Instruments Pty Ltd and should be available through the normal channels. We used a centre zero stereo balance meter for the tuning meter and for the signal strength meter we used a level meter marked "normal high". Both meters are catalogued under type HK35.

We are using three light emitting diodes in the complete unit, including the AM tuner which will come later on. A green LED indicates that the FM tuner is switched on, a red one indicates that the stereo decoder is in operation and a yellow one indicates that the AM tuner is switched on. These LEDS are made by Hewlett Packard and the type Nos. are—red, 5082-4684, green, 5082-4984 and yellow, 5082-4584.

Resistors and capacitors should present no problems. There is one point in the circuit however, which shows two capacitors in parallel. These are a 390pF polystyrene and an 82pF N750 ceramic, on pin 14 of the stereo decoder. These constitute part of the 76kHz oscillator circuit of the decoder and the combi-



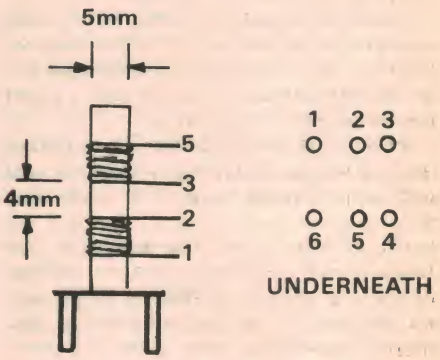
PCB stake connections: A,B stereo LED; C,D stereo switch; E 19kHz out; F mute switch; G signal meter; H tuning meter & tuner AGC; I,J AFC switch; K tuning meter; L mute switch; M 11.4V switch; N IF in; O left audio out; P right audio out. Pattern is actual size.

IF strip with decoder

nation has been selected to give temperature compensation as suggested by the IC manufacturers. However we were unable to get an 82pF N750 capacitor and so substituted an 82pF polystyrene type instead—with no drift problems. In fact the two capacitors may be replaced with one 470pF polystyrene unit, with quite satisfactory results.

Apart from a little care which should be exercised, construction of the unit is fairly straightforward. Before you buy the components, make up your mind as to whether to buy a ready made quadrature detector coil or wind one yourself.

If you decide to wind your own, then a few comments may help. If you settle for the single winding, then you will need the short 5mm diameter Neosid former. All that is needed is 22 turns of 22 B&S enamel wire, close wound and terminated on lugs 1 and 2. The winding must be firmly anchored with some tape or preferably coil dope or paraffin wax.



Depicted above are the winding details for the double tuned quadrature coil, together with the pin connections.

To wind the coil with two windings, you will need the longer former. The two windings are each 22 turns, as before, and should be equally spaced about the centre of the former. The spacing between windings must be an accurate 4mm—this is very important. The primary or bottom winding should be terminated in lugs 1 and 2 and the secondary winding should be terminated in lugs 3 and 5.

When the single winding is used, it and the 100pF capacitor must be shunted with a 3.9k resistor. In the case of the double winding, the primary (pins 1 and 2) must be shunted with an 8.2k resistor and the secondary with a 3.3k resistor.

Assembly of the printed board is best done by starting with the small components first and then working up to the larger components. Considerable care should be exercised in orientating the ICs correctly. This applies to the transistors, LEDs and polarised capacitors as well. We soldered the two larger ICs straight into the board but we used a socket for

the ULN2208. If you do not wish to try the higher gain ULN2209, then the socket may be dispensed with and the IC may be soldered straight in.

When assembling a unit of this type, care should be taken not to overheat the more vital components. The ICs should be considered in particular. A hot, clean iron, with a small tip is almost essential.

There are two 0.1uF capacitors shown on the circuit and indicated as being mounted under the printed board. These are the one on the +12V supply line input and the one across the 39k resistor. They may be mounted under the board as we have done, or you may choose to mount them across the appropriate terminal pins above the board.

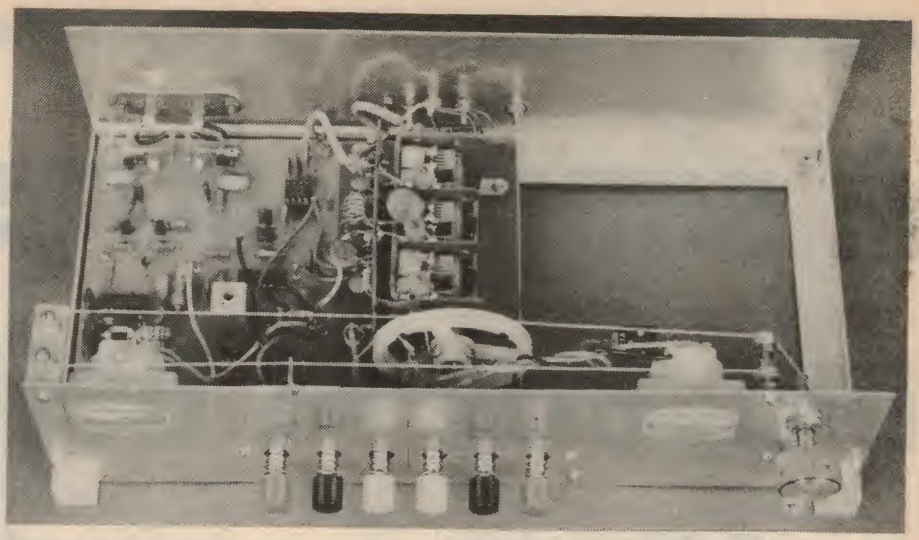
You may also notice that when the slug adjusting hole has been drilled for the quadrature coil, that there is little or no copper left across it. If this happens, a small piece of TC wire should be bent around the hole and soldered in place.

Having completed the assembly, a supply of a nominal 12V at about 100mA will be needed. At this stage, we propose to leave the builder to his own devices. A suitable supply will be described later on in a subsequent article.

We will assume that a power supply is available. Before switching on, it is wise to make a careful check of all the assembly, making sure that all components are in the right place and that due regard has been given to polarity, etc.

At this early stage in the construction of your FM tuner, no doubt many of you will want to make whatever checks and adjustments that can be done within the limits existing at present. Just what can be done now will depend upon whether or not you have a suitable signal generator, frequency counter and even a commercial tuner front end.

We will assume at this stage that you have a signal generator capable of being set to 10.7MHz. Alignment without a generator will be described when the complete tuner is discussed.



Shown in the early prototype stage, this state-of-the-art AM-FM stereo tuner is currently under development in our laboratory, and uses the IF strip and decoder circuitry described in this article. Full constructional details will be presented following articles on the various sub-stages.

Connect the two meters into circuit with long enough leads so that the meters may be conveniently placed for observation. As no switches have been provided at this stage, pieces of hookup wire should be used to simulate the required switch positions. Set the "switches" to FM, AFC Off, Mute Off and Stereo.

Switch on and check that all is well. Then connect the signal generator to the first ceramic filter. A requirement of this filter is that it works from a source of close to 330 ohms. If the source impedance of the generator is known, then extra resistance making it up to 330 ohms should be added in series with the generator lead. If the generator source impedance is not known, then a series resistor of say 270 ohms should be a fair compromise. Later on, when a front end is fitted, the 10.7MHz passband can be checked again and any inaccuracy due to matching may be adjusted.

With a 10.7MHz signal fed in from the generator, the signal strength meter should show some indication. Set the generator output level to give a meter reading about mid scale. Rock the generator frequency either side of 10.7MHz to determine the point of maximum reading. This will be close to the centre of the IF passband and the generator should be left precisely on this setting for the next series of adjustments.

During these adjustments, the centre reading tuning meter will have been making excursions to each of the extremes of its travel. Adjustments to the quadrature detector coil are made with the tuning meter. If you have a coil with only one winding, adjust the slug initially so that you observe a travel of the needle from one extreme to the other and then reverse the slug adjustment to bring the needle from the extreme position to exactly centre reading. This completes the adjustment of the single coil.

To adjust a double tuned coil proceed as follows. Remove the slug from the secondary winding. Adjust the primary winding slug as described in the previous paragraph, making sure that the meter needle is reading exactly in the centre. Insert the slug in the secondary and adjust until the meter shows a maximum deviation from centre, either one way or the other. Now adjust the primary slug carefully until the meter reads exactly centre again. That completes the alignment of the detector, and in fact all adjustments for the present.

In a following article we hope to describe a front end unit which, when combined with the assembly just described, will result in a first class FM tuner.

PARTS LIST FOR IF STRIP AND DECODER

1 Printed board 127mm x 102mm (EA 75FM5)
2 Murata ceramic filters, SFE-10.7MA-5
1 IC, ULN2208 (Signetics)
1 8-pin DIL socket (optional)
1 IC, TDA1200 (SGS) or CA3089E (RCA)
1 IC, MC1310P or XR1310P (Motorola, Exar, Signetics etc)
2 Transistors, BC109 or equivalent
1 Meter type HK35 centre zero "balance"
1 Meter type HK35 "level" or "S units"
1 RF choke, 22uH
1 Quadrature detector coil, double winding type 9300 (Transcap) see text
1 LED, green type 5082-4984
1 LED, red type 5082-4684
22 Printed board terminal pins (McMurdo)

RESISTORS
(½W or less unless stated otherwise)

1 330 ohms	*1 8.2k*
1 470 ohms	*3 10k*
2 680 ohms	*6 15k*
1 1k	*1 33k*
1 3.3k	*1 39k*
3 4.7k	*2 470k*
1 4.7k trimpot	*1 470k trimpot*

CAPACITORS
3 100pF 630V polystyrene
3 470pF 630V polystyrene (see text)
2 .001uF 200V polycarbonate
10 .01uf 63V ceramic or 200V polycarbonate
2 .022uF 200V polycarbonate
1 .047uF 100V polycarbonate
2 0.1uF 63V ceramic or 100V polycarbonate
2 0.22uF 100V polycarbonate
1 0.33uF 100V polycarbonate
1 0.47uF 100V polycarbonate
2 0.47uF 35VW tantalum or 100V polycarbonate
1 2uF 25VW tantalum or electrolytic
1 10uF 25VW electrolytic

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases if available, providing ratings are not exceeded.

A practical demonstration of the Doppler effect

A simple ultrasonic movement detector

This simple ultrasonic movement detector is not expensive and should prove invaluable as an educational aid for practical demonstrations of the Doppler effect. Based on two compact 40kHz transducer elements, the transmitter and receiver circuits employ just two ICs and a handful of peripheral components.

by J. BRIAN DANCE, M.Sc.

The Ultrasonic movement detector described here operates on the principle that the reflected radiation from a moving target undergoes a Doppler frequency shift. In fact, a double frequency shift is observed by the receiver since the target will move in respect to both the transmitter and the receiver, which are (for all practical purposes) fixed at a common location. This Doppler shift is a function of the transmit frequency (40kHz) and the velocity of the reflecting object.

Consider, for example, a target moving directly towards, or directly away from a 40kHz ultrasonic transmitter with a velocity of v metres per second. The Doppler frequency shift f is calculated from the expression $f = 2vF/S$Hz, where F is the transmitted frequency and S is the propagation speed of the transmitted frequency.

Since the propagation speed of ultrasonic sound waves is of the order of 300m/sec, a Doppler frequency shift of 400Hz will be observed for a target moving at a velocity of 1.5m/sec. The reflected signal will thus have an apparent frequency of 40,400Hz if the target is moving towards the transmitter, and 39,600Hz if the target is moving away from the transmitter.

As seen by the receiver, the Doppler shifted signal reflected from a moving target is mixed with 40kHz transmit frequency radiation reflected from stationary objects in the room. The phase relationship between these two signals will vary, giving rise to a varying DC output voltage signal, or audio beat tone, after rectification. This signal can then be amplified and fed to a loudspeaker.

A simple ultrasonic transmitter can be readily made up by connecting a miniature 40kHz transducer directly to a signal generator set at about 40kHz and producing either sine or square waves. The transducers themselves are normally obtained in pairs, the type 40T being the most suitable for the transmitter and the type 40R the most suitable for the receiver. Both types are available from Dick Smith Electronics Pty Ltd.

In fact, Dick has decided to offer a special deal on the transducer elements, the most expensive components

PARTS LIST

TRANSMITTER
1 40T transducer (see text)
1 HBF4001AE IC
1 22k, 1 470k ½W resistors
1 22k trimpot
1 180pf ceramic capacitor

RECEIVER
1 40R transducer (see text)
1 LM1808 IC
2 OA95 germanium diodes
1 330 ohm, 1 8.2k, 1 15k ½W resistors
3 0.1uF polyester capacitors
1 0.01uF polyester capacitor
1 5uF 25VW electrolytic capacitor
1 5uF 6VW electrolytic capacitor
1 100uF 12VW electrolytic capacitor
1 loudspeaker, 4 ohm impedance.

MISCELLANEOUS
Veroboard, hook-up wire, switches, batteries, solder, metal cases etc.

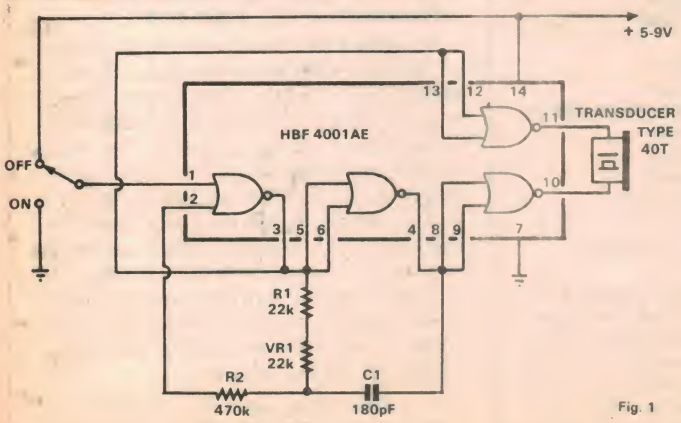


Fig. 1

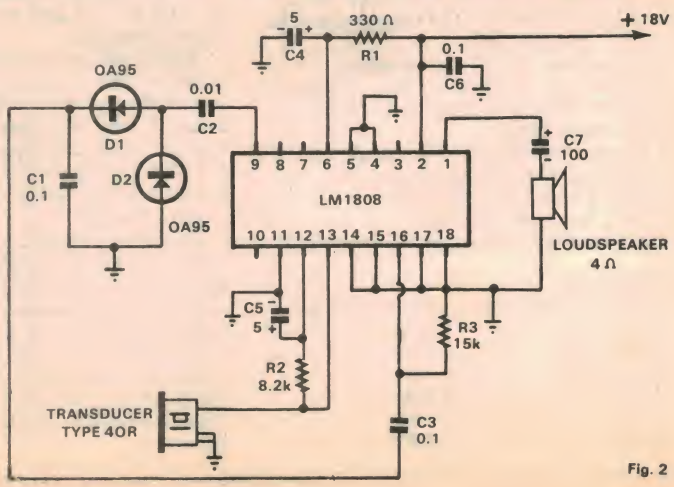


Fig. 2

Fig. 1 (above) shows the circuit for a simple ultrasonic transmitter, whilst Fig. 2 (right) depicts the receiver.

of this project. By enclosing the coupon on this page, EA readers will be able to buy the 40T and 40R transducer elements at the special introductory price of $10.00 per pair plus 50c for postage and packing. Considering the normal advertised price of $13.80 per pair, this represents very good value for money.

If a signal generator is unavailable, the circuit shown in Fig. 1 can be used to drive the transducer. This circuit employs the inexpensive SGS-Ates COSMOS type HBF4001AE integrated circuit—a quad 2-input NOR gate. Similar devices are available from other manufacturers, including RCA and Motorola.

As shown in Fig. 1, the two NOR gates on the left form a square wave oscillator, the frequency of which may be accurately set by means of the 22k trimpot VR1. The two NOR gates on the right act as buffer stages to drive the transducer in push-pull. Note that all of the NOR gates in the device are interchangeable, so that pin connections to the device may differ from those shown in Fig. 1.

Suitable receiver circuitry is depicted in Fig. 2. As before, this circuit is based on a single integrated circuit, in this case the new LM1808 device from National Semiconductor. As developed by the manufacturer, the 18-pin dual-in-line LM1808 device is intended for use in television sound IF strips. It contains a high frequency differential amplifier, a limiter, a volume control circuit (not used in this application) and a 2W audio power amplifier.

As shown in Fig. 2, signals from the receiving transducer are fed to an internal differential amplifier connected to pins 12 and 13. The signal level at this point may be less than 1mV. Output from the differential amplifier is taken from pin 9, where it has an amplitude of about 1V, and the signal applied to the diode pump D1 and D2.

If two frequencies are present at the receiver (i.e. a Doppler shifted frequency is present), a beat note is developed in the non-linear diode pump and the resultant audio signal appears across capacitor C1. This signal is then coupled via capacitor C3 to the input of the power amplifier stage at pin 16. The output from the power amplifier is taken from pin 1 and fed into a loudspeaker to produce an audible tone.

Note that it is not advisable to increase the value of capacitor C7. Doing so will allow very low frequency signals to reach the loudpeaker, possibly causing it to overload. These signals are too low in frequency to be heard anyway.

Constructional details are left to individual constructors. However, we suggest that the transmitter and receiver circuits be built up on Veroboard and mounted together with the transducer elements inside a standard metal diecast box. Alternatively, the transmitter and receiver circuits could be housed separately. Note that each circuit has different power supply requirements.

The setting up procedure is simple and straightforward. The receiver may be tested by applying power and tapping the transducer. This should cause a loud 'click' from the loudspeaker. The transmitter may now be switched on, and a voltmeter connected across capacitor C1 of the receiver circuit.

Place the two transducers close together, facing each other, and separate them until the meter deflection falls. This indicates that the circuit is no longer limiting. The frequency of the transmitter circuit is then adjusted by means of VR1 for maximum deflection of the meter.

Although the circuits described have been designed primarily to demonstrate the Doppler effect with ultrasonic waves, other applications are possible. For example, this type of circuitry can be used as a simple intruder alarm. It is left to individual constructors to make the necessary circuit modifications in order to incorporate a practical alarm device.

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An Upgraded Capacitor Discharge Ignition System

by LEO SIMPSON

With car maintenance and running costs rising all the time, there is an increasing demand for a reliable solid-state ignition system which is simple and easy to build. Here we present an upgraded version of the Capacitor Discharge Ignition system featured in August, 1970.

In the years since August, 1970, we have had some doubts about capacitor discharge ignition systems; in particular, about their reliability. These matters were discussed in the June 1973 issue, in an article entitled "Electronic Ignition reconsidered."

More recently, the rising costs of car maintenance and petrol have caused an increase in demand from our readers for an upgraded CDI design. So we set about coming up with a new unit which would provide reliability while reducing the total number of parts to a minimum.

A complex design has to be avoided as far as possible because apart from increasing the cost, complexity generally means increased chance of component failure. Of late, the author has seen some designs which seem so complex as to be ludicrous if the consequences of component failure were not so serious.

Our approach has been to upgrade the design featured in August, 1970. This was and still is a very popular design because of its simplicity, but it has been plagued by a number of problems which we hope have now been ironed out.

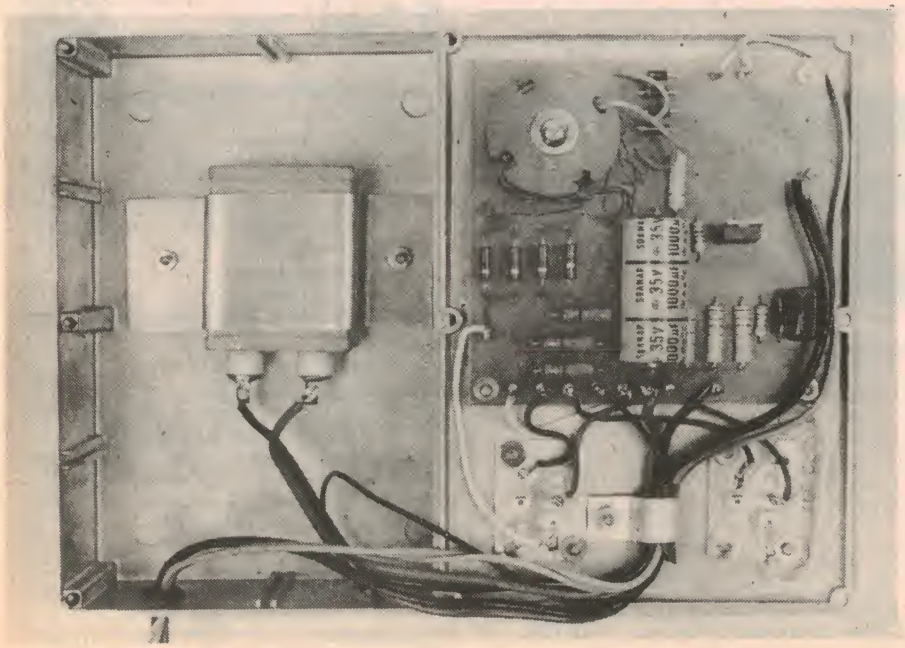
All circuitry in the new unit is accommodated on PC board measuring 10cm square. Besides simplifying construction and producing a more photogenic unit, the PC board reduces point-to-point wiring and the consequent risk of open-circuit connections. If you do decide to construct this unit, we strongly recommend using the PC board. In fact, take all possible care in assembling this unit since its reliability could be a matter of life and death.

Perhaps the first task to be undertaken in construction of the unit is to drill the necessary holes in the lid of the diecast case. We used an STC case measuring 172 x 120 x 55 mm but the Eddystone equivalent would be just as suitable, even though it is longer.

Both the PC board and the power transistors are mounted on the lid of the case. Use the PC board as a template for drilling the mounting holes. Similarly, use the mica washers for the power transistors as templates for the transistor mounting holes.

We also recommend that McMurdo TO-3 sockets (part number 2826-01-01) be used for the power transistors, because they result in more secure solder termination of the transistor leads. The transistors are secured to the sockets using self-tapping screws of an appropriate size.

Securing holes for the transistor sockets and the holes for the base and emitter of each of the transistors should be ⅛in diameter, while the holes for the self-tapping screws should be 3/16in diameter for adequate clearance.



TO-3 sockets are used for the power transistors to ensure trouble-free connections.

The inverter transformer uses two FX2242 ferrite core sections and a DT2180 Delrin single section bobbin, as supplied by Elcoma. At least one kitset supplier, Dick Smith Electronics, sells the bobbin with the 375-turn secondary wound on—which considerably simplifies the winding task.

If your bobbin is not supplied prewound, proceed as follows: wind the secondary with the aid of a hand drill clamped in a vyce. Two large flat washers (which can be made of Masonite), a long bolt and nut can be used to clamp the bobbin while the bolt is held in the drill chuck.

The washer next to the drill chuck should be suitably notched to allow the winding start to lay flat along the chuck during winding. The secondary uses 375 turns of 32 B&S double tough enamel (DTE) copper wire which eliminates the need for insulation between layers of the winding.

Begin by soldering the start of the winding wire to a 3in length of 5/.0076 (or similar) PVC hookup wire. Lay this across the width of the bobbin and anchor it with a short length of electrical insulation tape. Wind on 375 turns as evenly as possible. Cover this with two layers of insulation tape and terminate the finish in the same way as the start.

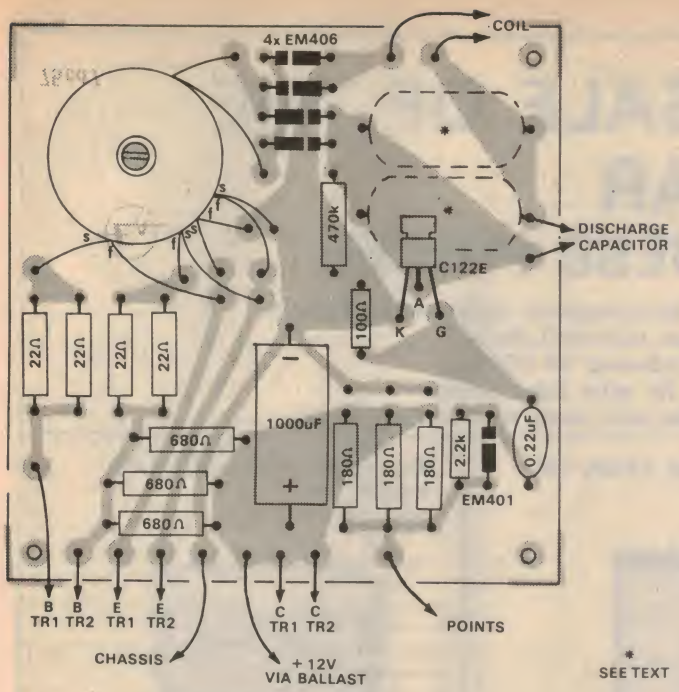
Leads for the primary and feedback windings need not be terminated as for the secondary—just leave the starts and finishes of the windings about six inches long, and cover with spaghetti sleeving. The starts and finishes should be securely anchored on the bobbin with insulation tape. The feedback windings are wound over the secondary, and the primary winding last. Both feedback and primary windings are wound bifilar, ie., both sections of each winding are wound simultaneously, with two wires together wound as one wire.

Use 28 B&S enamelled copper wire for the feedback winding (6 turns bifilar) and space the turns out to occupy the full width of the bobbin. The 13 turn (26 B&S) primary winding should be wound in the same direction as the feedback winding. Start and finish of each winding should be labelled S(start) or F(finish).

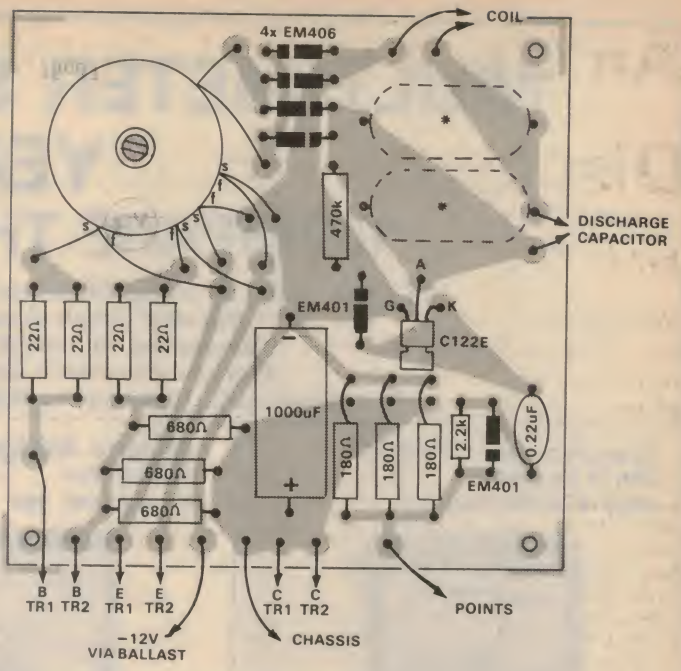
Finally, finish the winding with a couple of layers of masking tape to anchor it. (Insulation tape tends to unravel.)

Place the completed bobbin in the two cup core halves, making sure that the core faces are clean before clamping. If there is dirt on the faces, the cores may crack when clamped, or the converter may squeal excessively and the transistors overheat.

We are of the opinion that it is unnecessary to impregnate or "pot" the transformer winding. For impregnation to be an effective guard against corrosion in the windings due to moisture, all the moisture must first be removed. Impregnation or pottings, as done by amateurs without access to vacuum apparatus, does little more than lock moisture in. In any case, the heat produced during normal operation of the



NEGATIVE CHASSIS

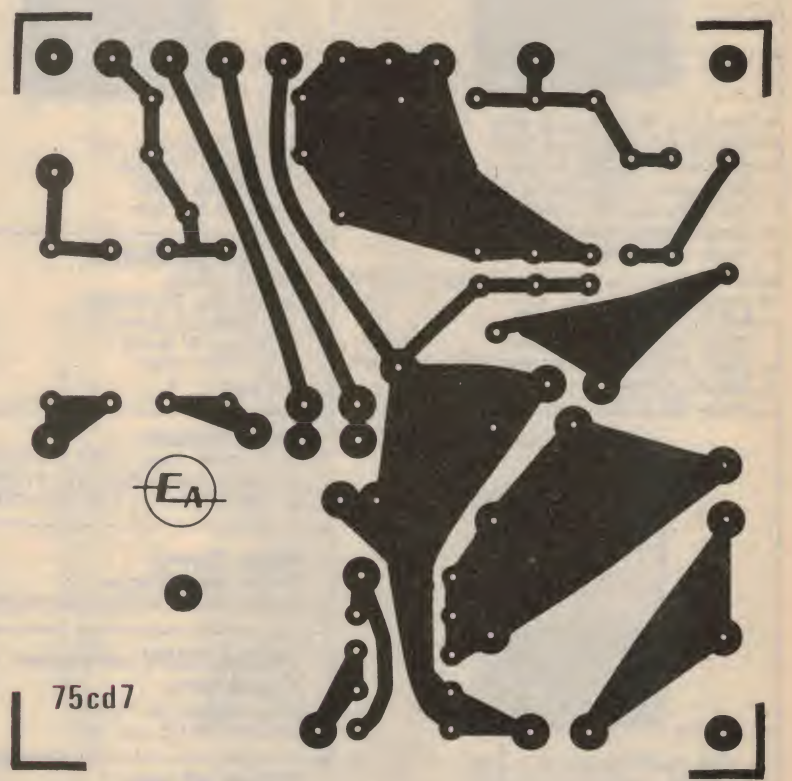


POSITIVE CHASSIS

* SEE TEXT

PARTS LIST

1 STC diecast case, 172 x 120 x 55mm.
2 FX2242 ferrite cup cores.
1 DT2180 Delrin former.
2 2N3055 silicon NPN power transistors.
4 EM406/BY127/600 silicon power diodes.
1 EM401 silicon diode.
1 C122E silicon controlled rectifier.
CAPACITORS
1 x 1000uf/35VW electrolytic capacitor.
1 x 1uF/600VW paper capacitor, Ducon 3S10A.
1 x 0.22uF/100VW metallised polyester capacitor.
RESISTORS (5 or 10% tolerance).
1 x 470k/1W, 1 x 2.2k/½W, 3 x 680 ohms/1W, 3 x 180 ohms/1W, 1 x 100 ohms/½W, 4 x 22 ohms/1W.
1 PC board 100mm square, 75cd7, 2 McMurdo TO-3 sockets, part number 2826-01-01
2 McMurdo TO-3 covers, part number 9151-09-01.
2 TO-3 mica washers.
13 PC stakes.
2 eyelet/solder lug assemblies (see text).
MISCELLANEOUS
Double-tough enamelled copper wire (26, 28 and 32 B&S), spaghetti sleeving, masking tape, epoxy adhesive, grommet, solder lug, pop rivets, screws, nuts, lockwashers, 4 ⅜in x No 6 self-tapping screws for TO-3 sockets, ½in x No 10 self-tapping screws for unit mounting, bracket for discharge capacitor, 23/.0076 figure-8 cable, cable clamp, solder, silicone grease or heatsink compound.



unit should serve to keep moisture out of the windings.

The transformer is secured to the board by the clamp screw, which should be 3/16in diameter and 1½in long. Use washers on the screw head side of the core and underneath the clamp nut, so that the board is not cracked.The clamp screw also secures the PC board to the lid of the case, along with the three other screws.

Strip the enamel insulation from the wire ends and terminate according to the circuit diagram. This done, the remaining components can be mounted on the PC board.

Note that R1, R2, R3 and R5 are parallel combinations of 1 watt resistors. This was done for two reasons: (a) they are cheaper than equivalent wirewound resistors and (b) their surface temperature rise is not as great as equivalent wirewound types. Some wirewound resistors become so hot as to char the PC board, even when they are considerably derated.

R4, 470k, is also a 1 watt resistor in order to obtain an adequate voltage rating (500V). ½W resistors have only a 350V rating.

IRH type GL1 metal glaze resistors are the recommended 1W resistors for this unit, with carbon film types being second choice. The GL1 resistors are rated at 1 watt up to 70 degrees Celsius (ambient) and have a low surface temperature rise.

The rectifier diodes should have a rating of at least 600 volts or higher. Those recommended are EM406 or BY127/600.

The recommended SCR is the General Electric plastic encapsulated C122E, which has a repetitive peak blocking and reverse voltage

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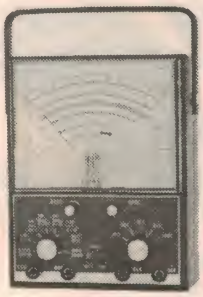

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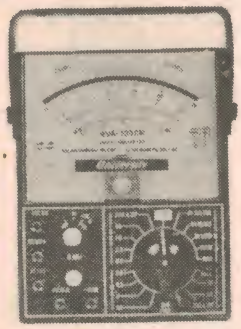

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rating of 500 volts and a high dv/dt rating of 50 volts per microsecond (typical). It has the advantage that it can be soldered directly to the PC board and does not require a heatsink. We do not recommend any alternative SCR.

Note that the orientation of the SCR is reversed in the positive chassis version. In both versions, the SCR leads are splayed apart to fit the PC board.

The discharge capacitor presents us with a dilemma as far as component specifications are concerned. The ideal capacitor to use is the Plessey Ducon 5S10A or 3S10 which have been specifically designed for high discharge current applications. This is shown in the photograph of the prototype and is specified in the parts list.

We understand, however, that these capacitors are quite expensive and are often difficult to obtain.

The only alternative which is readily available is to use a 1uF (or two 0.47uF units in parallel) polycarbonate capacitor. Now if the specifications of these capacitors are taken at face value then they are just not suitable for this application. But at least one kitset supplier indicates that he has sold over one thousand CDI kits with polycarbonate capacitors and he has not had a single complaint.

Further evidence in their favour: We have bench-tested this CDI using polycarbonate capacitors under quite stringent conditions (at very high spark rates and at case temperatures up to 80 Celsius) and we were not able to record a single failure or deterioration in performance.

So while we would prefer to see the 5S10A or 3S10 capacitor as the one used by all constructors, it does seem as though polycarbonate capacitors (with a minimum rating of 630VW) are a viable alternative and we have made provision for them on the PC board.

If you do use a polycarbonate capacitor, it should have a voltage rating of at least 630VW.

The 1000uF/35VW electrolytic capacitor should be firmly secured to the PC board with an Epoxy adhesive such as Araldite. If this is not done, there is a danger that the weight of this relatively bulky component will cause the leads to break as it will be subjected to acute vibration.

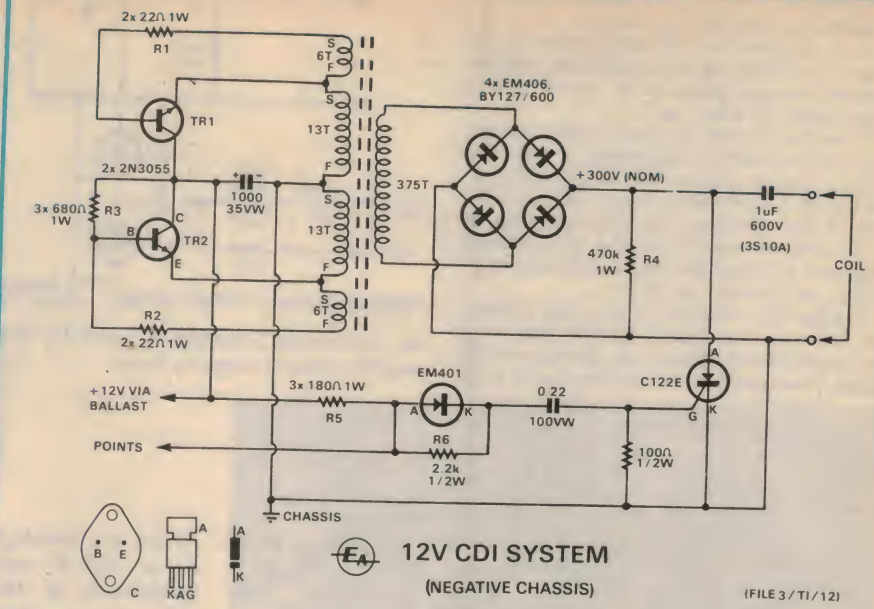
PC stakes are used for external connections to the PC board. Any type may be used, provided they are a tight fit in the PC board holes before soldering. When terminating wires to the stakes, wrap the stake securely with the wire and then solder.

Use pop-rivets and washers or screws, nuts and lockwashers to secure the McMurdoTO-3 sockets. Before mounting the transistors, ensure that the contact area is completely smooth and free of burrs and swarf. Smear the contact surface and the underside of the transistors with silicone grease or heatsink compound. If you are building the negative chassis version you will need to use a mica washer for each transistor to isolate it from the case.

We used TO-3 transistor covers from McMurdo (part number 9151-09-01) to eliminate the possibility of short circuits where tools are inadvertently dropped onto the transistor cases. The covers may be omitted in the positive chassis version.

When mounting the PC board on the lid of the case do not neglect to use lockwashers under all nuts, otherwise everything will rattle loose within the first few kilometres.

A suitable bracket will have to be made to mount the oil-filled discharge capacitor on the floor of the case. Connecting wires from the capacitor to the PC board and from the CD system to the rest of the vehicle should be



HOW THE CIRCUIT OPERATES:—

The converter consists of two silicon NPN power transistors in a transformer coupled oscillator. Self-starting under full load conditions is assured by the asymmetrical biassing provided by R3. Operating frequency is about 3kHz.

The square wave voltage impressed across the primary windings appears across the secondary winding multiplied by the turns ratio and is rectified by a bridge rectifier to produce 300 volts DC with a 12V DC input. The 1uF discharge capacitor is charged from the rectifier via the primary of the ignition coil.

A silicon controlled rectifier (SCR) is used to discharge the 1uF capacitor and thus apply the full 300 volts DC to the ignition coil primary. The coil then acts as an "impulse transformer" to fire the spark plug.

The spark plug firing voltage is set by the plug gap and the gas pressure inside the cylinder and so is independent of the type of ignition system used. But since the energy applied to the ignition coil primary is much higher than in the conventional system and the "rise time" is much faster, the spark energy is greater and the chance of plug misfire is correspondingly less.

While the 1uF capacitor is being discharged, the converter stops functioning because it is effectively loaded down by a short-circuit. The converter does not restart until the SCR reverts to the non-conducting state. It then recharges the 1uF capacitor very rapidly. In fact, the capacitor is recharged to better than two-thirds of the final voltage in the first two cycles of converter operation.

Because of the square converter waveform and the rapidity with which the discharge capacitor is recharged there is a risk that the SCR can spontaneously beak over into conduction due to the mechanism known as "dv/dt switching". To avoid this possibility we specify an SCR with excellent dv/dt ratings and ensure that the gate is tied to the cathode via a low impedance path.

In the negative chassis version, this low impedance is set by the 100 ohm resistor R7 while in the positive chassis version it is provided by the series diode in the cathode circuit of the SCR.

The 470k resistor R4 is incorporated to prevent spikes from the converter charging the capacitor to higher than the nominal voltage when the motor is merely idling. It may be said to improve the load regulation of the converter. Resistor R4 is specified as 1W in order to provide a 500V rating.

Readers familiar with the original version of this circuit will note that it has a lower output voltage than the original: 300 vs 400. This has resulted largely from using a lower value of R3 than was originally specified which effectively damps the spikes and their energy content in the output waveform.

Positive trigger pulses to the SCR are generated in the following manner. When the distributor points are closed, current flows through R5. When the points open, the junction of R5 and R6 is suddenly raised to the full 12V and the associated diode charges the 0.22uF capacitor to 12V via the SCR gate and parallel resistor R7. This fires the SCR and discharges the 1uF capacitor. The trigger network is then inoperative until the points again close which enables the 0.22uF capacitor to discharge via R6. The choice of R6 is a compromise between obtaining an effective short discharge time for the 0.22uF capacitor, and thus allowing a high spark rate, and points bounce suppression.

The choice of R5 (which is three 180 ohm resistors in parallel) is also a compromise between adequate points "wetting" current on the one hand and power dissipation inside the CDI case on the other.

The trigger circuit for the positive chassis version is a cunning variation of the negative chassis version. Here, when the points open, the junction of R5 and R6 is rapidly taken negative and the 0.22uF capacitor charged to 12V negative via the SCR cathode and gate. Thus, although the gate is tied to chassis, it is effectively raised above the cathode because the cathode is "pulled" negative. Thus the SCR triggers.

of reasonably heavy current capacity, such as 23/.0076 figure-8 cable or heavier.

When assembly of all components in the case is complete and all connections double-checked, its operation can be tested, before being installed in the car.

Operation can be checked without having a coil connected by substituting a 100 ohm resistor. On no account should the coil connections be merely bridged out with a jumper wire. If the discharge capacitor is energised in this situation and the SCR is inadvertently triggered, the resultant short-circuit discharge current will destroy the SCR.

Energise the converter from a 12V battery. (At this stage we should remark that some regulated power supplies will give misleading results when used with converter loads.) With the converter energised, the transformer should emit an audible whistle and the voltage across the discharge capacitor should be close to 300 volts DC.

If the converter does not "burst into song" when energised, check the transformer connections and swap around if necessary.

If the converter output voltage is above 300V by more than ten percent when using a 12V battery (which actually measures 12V) then there is a fault condition. For example, if the output voltage is 500 volts DC or more, there is a strong possibility that one of the transformer connections is open-circuit and/or one of the transistors defective.

Under these conditions, the transformer operates in a "spurious" ringing choke mode which if allowed to continue can cause the failure of the remaining transistor and the SCR.

Another possible cause of higher than expected output voltages (say 350 to 400V) is that the 1000uF/35VW capacitor is partially or completely open-circuit or perhaps incorrectly polarised. The first possibility is easily checked by bridging with a known good capacitor.

Note that the converter output voltage is directly proportional to the battery voltage: At 12V in, output is 300V DC; at 16V in, output is 400V DC.

Operation of the SCR trigger circuit cannot be checked at this stage unless the 100 ohm resistor substituting for the coil primary has a rating of several watts.

Current drain of the converter is about 500mA at idle while the SCR trigger network resistors (3 x 180 ohms in parallel) set the current through the points at 200mA.

Having tested the converter for correct operation, the CDI system may be installed in the car.

In the light of past experience, we do not recommend the use of octal plugs to enable changeover from CDI to normal operation. Contact resistance in these plugs can develop after a period of time and cause intermittent operation. For the same reason, we frown on those designs we have seen using push-button or slide switches for the changeover function. Slide switches are particularly dicey in this regard because mere vibration can shift the "slide" to a point midway between the two settings.

We favour a system of changeover whereby the original vehicle wiring is left unaltered. To this end, we have arranged with Watkin Wynne Pty Ltd to make available an eyelet/solder lug assembly which accommodates the existing wiring to the coil and the additional wiring from the CDI system.

As shown in the photograph of a mock-up coil installation, an eyelet/solder lug assembly is attached to each terminal post of the coil and the wires from the CDI system are soldered to the lugs. Thus the two coil wires from the CDI system are terminated at the coil terminal posts and the outrigger terminals remaining are used to connect the 12V supply (via ballast) to the CDI and the points wire to the SCR trigger network.

With this arrangement, it is easy to restore the vehicle to the original ignition system if the CDI has to be removed, as in the case when the car is sold.

For those who wish to make up their own eyelet assemblies, the material we recommend is canvas reinforced bakelite, red vulcanised fibre (as used for making washers) or woven fibreglass board (similar to that used in PC copper laminate). Minimum thickness of material is 1/16 inch. The eyelets should have an internal diameter of 3/16 inch or to suit the terminal posts of the coil in the vehicle.

There is no need to run an extra wire from the ignition switch to bypass the ballast resistor (or ballast wire in many vehicles). The voltage drop across the ballast resistor due to the converter current drain (the resistor is typically about 1 ohm) is fairly modest and does not impair the CDI operation. Even at high spark rates where the converter current increases, the battery voltage tends to rise anyway because of high generator speed and thus compensates to some extent for the ballast losses.

Painting the case black is optional. It is doubtful whether painting the box would improve heat transfer.

Installation of the CDI unit may prove to be a problem in many cars as space can be very limited. The unit should be kept as far away as possible from the heat of the exhaust manifold and should not be mounted low down where it will often be splashed with water. if space can be found, a position either left or right of the radiator, where there is good airflow, is just about ideal.

On some cars, the only space to mount it will be on the firewall. If this is the position decided upon the CDI case should be mounted on a pad of asbestos or polystyrene foam, to avoid its annoying whistle being radiated into the passenger compartment.

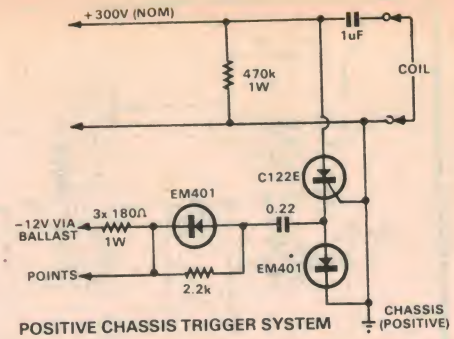
It the unit is mounted on a flat surface, it can be attached simply by drilling three or four holes through the floor of the case and through the associated panel and secured with self-tapping screws. If mounted on a curved surface, suitable brackets will have to be fabricated.

Make sure that the CDI case is solidly connected to the car chassis because it forms the electrical path for the converter current drain and the SCR trigger current.

Spark plug and points gap settings should be set as for conventional ignition. Using a wider spark plug gap will increase the tendency for the insulation of the coil and spark plug leads to be broken down, and will render the system inefficient if changeover to the conventional system is needed.

All spark plug cables and connectors should be in good condition and care should be taken not to have individual cables too close to each other to the engine block or head. It may even be necessary to make spacers for the cables using a material such as Paxolin or SRPB (synthetic resin paper board). This last measure will almost certainly need to be employed if the car runs erratically due to cross-fire or cable breakdown.

TVRS (television and radio suppression) ignition cables should be replaced with standard cable if their resistance is much above 20k per lead, as checked with an ohmmeter.



POSITIVE CHASSIS TRIGGER SYSTEM

An interesting variation is used for the positive chassis trigger circuit.

At left is a mockup of a typical coil connected to the CDI system using two eyelet-solder lug assemblies. Those supplied in kits will be somewhat more robust than shown here.

1/16" MINIMUM THICKNESS
CANVAS BAKELITE
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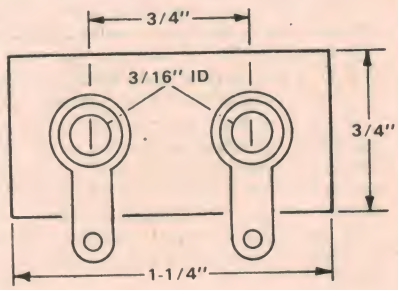

EYELET/SOLDER LUG ASSEMBLY

Two of these eyelet-solder lug assemblies will be needed for connection to the coil.

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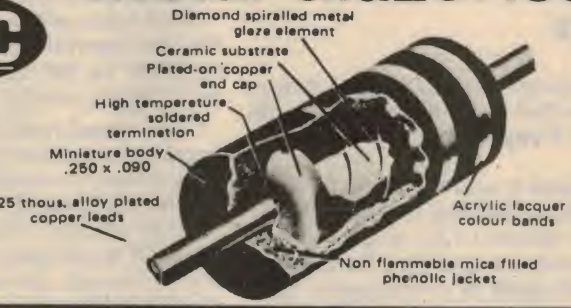

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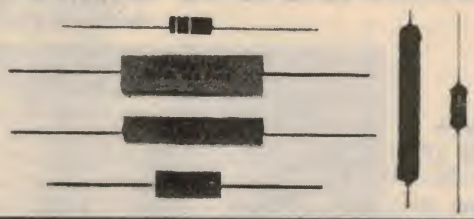

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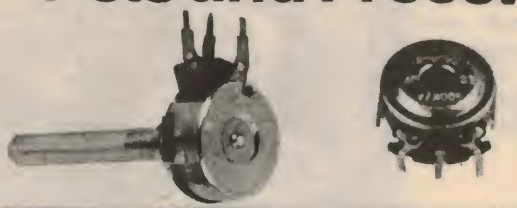

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G/5.74

LED flasher based on inexpensive IC

Here is a new IC, designed expressly for flashing light emitting diodes, which is capable of operating from a single 1.5V battery, with a current drain as small as 0.32mA. Needing only one external component, a LED can be flashed for over two years, using a single cell.

by DAVID EDWARDS

The LM3909 is a monolithic oscillator specifically designed to flash LEDs (Light Emitting Diodes). By using the timing capacitor for voltage boost, it delivers pulses of 2V or more to the LED, while operating on a supply of 1.5V or less. The circuit is inherently self-starting, and requires the addition of only one capacitor to function as a LED flasher.

Packaged in an 8-lead plastic mini-DIP, the LM3909 will operate over a temperature range of −25°C to +70°C. It has been optimized for low power drain and operation from weak batteries. In continuous operation it should give at least the life calculated from the battery manufacturer's data; probably more due to a favourable end point voltage.

Application is made simple by inclusion of internal timing resistors, and an internal LED current limit resistor. The timing resistors supplied are optimized for nominal flashing rates and minimum power drain at 1.5V and 3V.

Fig. 1 is the schematic diagram of the LM3909, and also shows how it is used to flash a LED from a 1.5V battery. Transistors Q1 and Q4 form a bistable pair, while Q2 and Q3 provide current gain. Zener diode D1 protects Q3 from damage when driving an inductive load.

On first turning on, the 300uF electrolytic capacitor is not charged, Q4 is biased on and Q1 is biased off. The capacitor commences to charge through the two 400 ohm resistors, and the resistance selected at pins 1 and 8 (3k in this case). The time constant of this charging process is principally determined by the selected resistance.

As the capacitor charges, the voltage at pin 8, and hence the emitter voltage of Q1, falls. The base voltage of Q1 is held constant by Q4 acting as an emitter follower. After about 1 second, the BE drop of Q1 is exceeded, and Q1 commences to turn on.

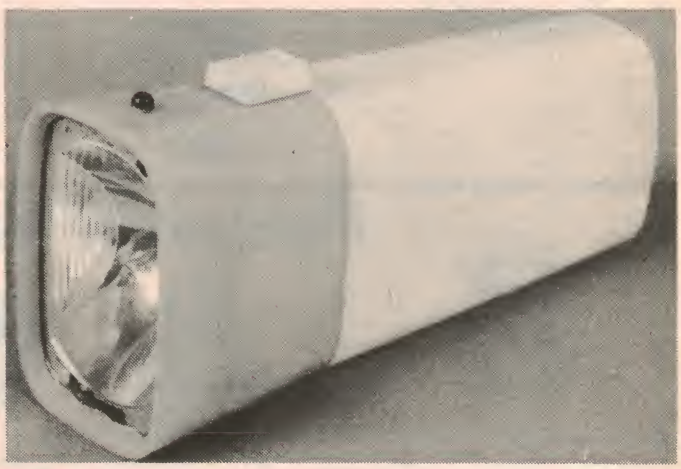
In a regenerative action, Q4 turns off, and Q1 turns on. This in turn turns on Q2 and Q3, which then shorts the positive side of the capacitor to ground. This means that the negative side of the capacitor is forced to a potential below ground, so that the voltage between pin 5 and pin 8 approaches 2.5, with pin 5 positive.

This voltage is applied across the LED, via the internal limiting resistor, and exceeds the inherent 1.6V drop. Forward current commences to flow through the LED, which emits its characteristic light, while the capacitor commences to discharge. The time constant of this process is determined by the 12 ohm limiting resistor.

When the capacitor is almost discharged, Q4 is biased on, and Q1 off, and the discharge process stops. The capacitor then commences to recharge, and the cycle starts again. The duration of each flash is determined by the capacitance value, and by the discharge resistor. The interval between flashes is determined by the capacitance value and the charging resistor.

The internal resistors provided for this purpose have been optimised for minimum power consumption at 1.5V and 3V, at the recommended flash rates. Figure 2 shows how to connect the LM3909 for use with these battery voltages. Both of these circuits provide a light which flashes at 1Hz.

These two circuits operate with average current drains of 0.5mA and 0.8mA respectively. The 1.5V version has an estimated life of 3 months with one AA size cell, 7 months with one C size cell, and 15 months with one D size cell. If alkaline cells are used, these estimates can be doubled. As the 3V version uses slightly more current, the estimated life would be slightly less, although a brighter flash is produced.



Find your torch in the dark. The LED in this torch—black moulding near the front—flashes once every second continuously. The torch uses AA cells and their life would be shortened slightly. Larger batteries would be less affected.

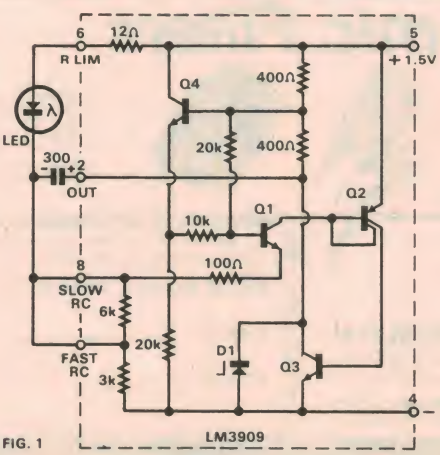


FIG. 1

Fig. 1. Schematic diagram of the LM3909, with external components to make a complete flasher.

On the above figures the use of an alkaline cell may be hard to justify on purely economic grounds, since it costs approximately 3.5 times as much as a standard cell, yet gives only twice the life. This is normal, and the alkaline cell will really only justify its higher cost at heavier current drains where it can, in some circumstances, give up to 10 times the life of a standard cell.

On the other hand, there may be factors other than the cost of the cell that

would justify the use of the alkaline variety. Where continuous operation over a long period, without attention, is the primary requirement, the higher cost of the alkaline cell may be of minor importance.

The battery life figures quoted were taken from the National Semiconductor Corporation's literature on the LM3909 and have been confirmed by a local battery manufacturer.

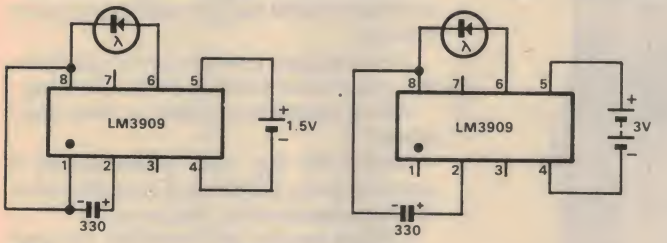


FIG. 2 NOMINAL FLASH RATES 1Hz

Fig. 2. External connections for either 1.5V or 3V operation. The higher voltage increases current drain but gives a brighter flash.

Applications for these two circuits are almost endless. Located above fire extinguishers and emergency exits, they serve to indicate their positions if other power supplies fail. As sales and advertising gimmicks, they can draw attention to desired products or services. One use around the house would be to serve as locators for keyholes and/or doorknobs in conditions of poor ambient light.

Since the current drains of these circuits are so small that, for larger batteries, the operational life is not seriously diminished by their use, it is possible to fit them into torches as locating aids without significantly shortening the shelf life of the batteries. We did this, and the result is shown in the photographs. As there are only two components apart from the LED, it is relatively easy to find a place to fit them inside the torch. We used the space behind the reflector.

The next circuit, shown in Fig. 3, is for a "Buzz Box Continuity and Coil Checker". This can also be used as a Morse code practice buzzer. Apart from a small loudspeaker and a battery, the only other components required are a resistor and capacitor. In operation, an audible note is produced when the test probes are joined together. The pitch and tonal quality of this note is dependent on the resistance and inductance of the components used to connect the probes. Differences between shorts, coils and a few ohms of resistance can be heard.

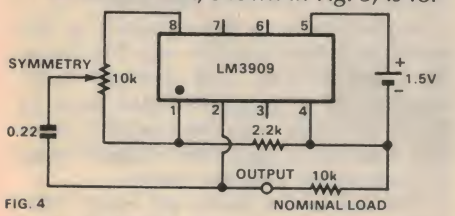


FIG. 4

Fig. 4. A simple square wave generator using the LM3909. Frequency may be altered by varying the capacitor.

For use as a Morse code practice oscillator, the test probes are replaced by a standard Morse key. If desired, the operating frequency can be varied by changing the capacitor. One advantage of this circuit is that an on/off switch is not required, since no power is consumed when the probes are open circuit. A second advantage is that it has a low power drain.

Fig. 4 shows how the LM3909 may be connected as a square-wave oscillator, powered from a single 1.5V battery. With the values as shown, the frequency is 1kHz, and the voltage swing across the nominal 10k load resistor is from 0.1V to 1.2V. The frequency may be altered by changing the value of the capacitor. The 10k pot is used to adjust for a symmetrical waveform.

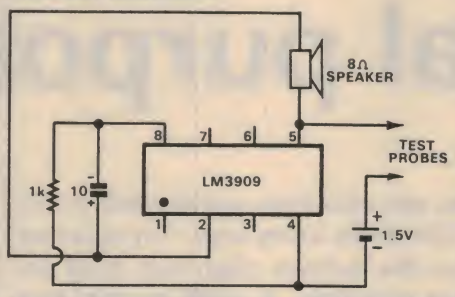


Fig. 3. A simple audio oscillator which may be used as a continuity tester or Morse code oscillator.

The LM3909 may also be used to obtain a continuous light, rather than a pulsed one. The circuit of Fig. 5 requires only 4mA of current. The LED is supplied with short, high current pulses at 2kHz, and appears to be on continuously.

The final circuit, and perhaps the most useful, is for a low drain pilot light, for use with battery powered equipment. Fig. 6 shows the basic scheme. The zener diode is used to drop the excess supply voltage so that the flasher circuit obtains its correct voltage. The zener voltage is chosen so that the total voltage of the zener and the flasher circuit equals the supply voltage. Thus for a 9V supply, we would use a 1.5V flasher and a 7.5V zener diode.

The total current drain of the circuit is the same as that of the 1Hz flasher, so that in the case quoted above, it would be 0.5mA on average. Thus the total power dissipated in the complete circuit would be 4.5mW. The total component count is four, while the total cost should be less than $3.00. The LM3909 retails at $1.05 plus tax, so this is the major part of the cost. Needless to say, it would not be possible to achieve the low power drain of the LM3909 using discrete components without spending a great deal more.

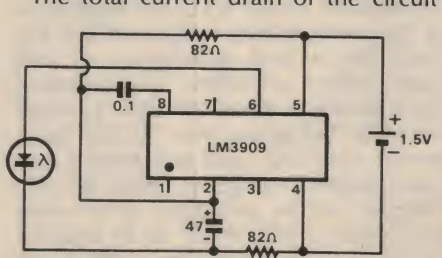


Fig. 5. The LED will appear to glow continuously when fed pulses at 2kHz from this circuit.

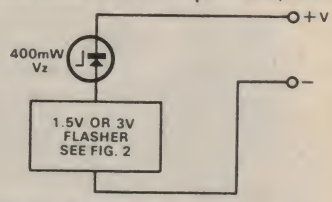


FIG. 6

Fig. 6. A low drain pilot light for battery equipment. It flashes at 1Hz while ever the equipment is on.

A few points are in order at this stage concerning the choice of components for these circuits. Although almost any LED can be used, we found that those fitted into bezels did not have the visibility of those without bezels, particularly at large angles to the axis. This means that it is better to use the latter type of LED, as it is more easily seen from the side. As a bonus, these LEDs are usually cheaper.

The electrolytic capacitors should be rated at 3V or more. Most electrolytic capacitors have large tolerances on their capacitance, so that it may be necessary to trim up from a lower value to obtain the correct flash rate.

The resistors shown in the various circuits can all be ¼W, while the small capacitors in Figs. 4 and 5 can be of almost any type, as they are not highly stressed. Pins 3 and 7 have no internal connections, so they can be used as tie points for the external components.

We have not provided constructional details for any of the circuits, as this will depend on the manner in which they are used. Perhaps the easiest method would be to use small pieces of 2.5mm spacing Veroboard, with all components soldered directly to it. When soldering the LM3909, take care not to apply too much heat, as this may damage it.

A general purpose player

Here's a stereo record player that you can assemble without too much strain, either on your pocket or your electronic know-how. Put together from oddments, it would be ideal for the rumpus room but, built up from the kit available through various suppliers, it could be featured in the living area.

by DAVID EDWARDS & NEVILLE WILLIAMS

We have described any number of integrated record players over past years, but there seems always to be room for one more—particularly if someone comes up with a product which makes the idea easier, or cheaper or better. In this case, the key product is a pre-assembled stereo amplifier module currently being imported by Dick Smith Wholesale Pty Ltd and available through as many suppliers as care to handle it.

The module was actually reviewed in our May '74 issue and has been available since in limited quantities. Recently, however, new and larger stocks have come to hand making it possible to do what we had in mind originally—to feature the module in a basic mains-operated record player.

The module consists of a PC board assembly measuring 113 x 90mm, to which is attached a wrap-around aluminium bracket carrying (and forming a heatsink for) the two pairs of output transistors. A small outrigger board, held in place by nylon standoffs, carries additional circuitry which extends the basic amplifier to a complete stereo module with full volume, bass, treble and balance facilities.

We have not reproduced the full circuit here, since it is not essential to the constructor who only wants to make peripheral connections to the module. In any case, a copy of the circuit is available for reference from the distributors at 160 Pacific Highway, Gore Hill, NSW, 2065. It shows that, electrically, each channel consists of a one-transistor preamplifier, a passive tone control system, and a conventional 4-transistor main amp with complementary class-B output stage, negative feedback and an output coupling capacitor.

The acoustic power output available will depend on the level and regulation of the power supply voltage, and on the impedance and efficiency of the loudspeakers provided. The amplifier can typically be operated from a simple 4-rectifier bridge fed from 20-22V transformer secondary and delivering a no-signal supply voltage of about 30VDC. Filtering can be provided by a single electrolytic, which might be as small as 1000uF but which could be increased to advantage to 2500uF or higher, for reduced hum.

In these circumstances, the electrical power output from the amplifier is likely to be 6 to 7 WRMS per channel with a distortion content ranging from just under 1% THD at typical room volume to about 2% approaching overload. This is somewhat higher than accepted hifi standards but quite acceptable for an amplifier that is going to be used with a non-specialist pickup and loudspeaker system.

To make up a complete record player, the constructor will need the following:

Stereo amplifier module as described above.

Three 50k log dual potentiometers (volume, bass, treble) and one 50k linear single potentiometer (balance).

Control knobs and possibly a panel plate.

Power supply components (switch and indicator light optional).

Record playing deck complete with stereo crystal or ceramic cartridge.

Base to accommodate deck and amplifier, preferably complete with perspex cover.

Two loudspeaker systems.

The usual "sundries": power cord, wire, solder, screws etc.

Dick Smith's catalogue, published with our April '75 issue, gives a good guide to the likely cost of these various items. The relevant page of the catalogue is 40a under the heading "Project 250"—his title, not ours!

Fundamental to the project is the stereo amplifier module which is being marketed directly and through other suppliers at a suggested retail price of $14.95. Included with the module is a circuit and instructions which can be read in conjunction with this article.

The rest of the items are quite standard and could variously be bought, salvaged or contrived, according to the constructor's own initiatives. However, the aforementioned supplier(s) will presumably be offering the module plus potentiometers for $19.95; or module plus potentiometers plus power supply components for $29.95 (pack and post extra in all cases).

As indicated earlier, the amplifier can be used with any ordinary medium to high output crystal or ceramic cartridge

Above: the complete player built up from parts suggested in the recent Dick Smith catalogue. At right: the wiring diagram. Our inclination would be to trim off the ends of the panel and delete the extra controls, leaving only the four essential knobs and the indicator lamp.

installed in any normal playing deck or changer. This, in turn, can be mounted on any available base, whether bought or home-made, provided there is room to fit everything in and without having the drive motor fall too close to the amplifier and wiring.

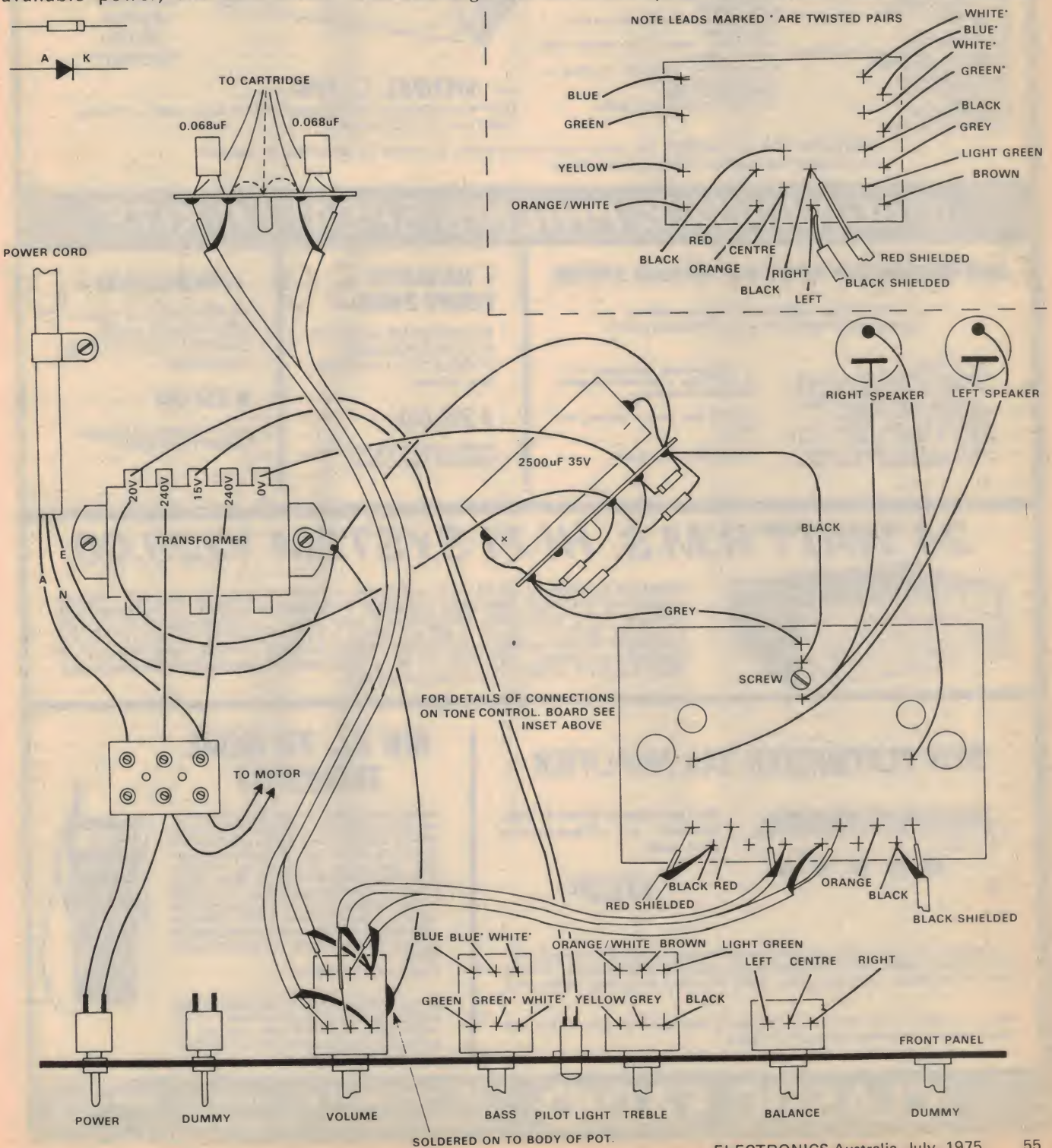
However, a base to suit the purpose is available for $9.50, a perspex lid for $11 and a BSR automatic changer with cartridge for $44.00.

As far as loudspeakers are concerned, it is logical to choose sensitive wide-range types, to make the best use of the available power, and of 8 ohms impedance. There is room here for bargain hunting and handyman initiative but, again, the Dick Smith catalogue offers the SP620 system with 8in woofer and 2in tweeter complete in a fully finished enclosure for $24.50 each. They are strictly an economy design but they are neatly finished and provide acceptable sound.

Allowing for possible incidentals like a fascia panel, mains switch and indicator light, this would add up to about $150 for a complete record player that would certainly look the part, be equipped with a record changer and deliver an output of about 7W RMS per channel.

Most of the information you will need to assemble the player can be obtained from the accompanying diagram, which is more detailed than available from the distributor's own literature.

Beginning with the power supply arrangements, the incoming 3-way power flex should be clamped securely inside the case to take any stress to which it may be subjected. The earth lead should be looped through and soldered to a lug secured under the transformer mounting screw. Further wiring, radiating from this point, earths the amplifier via



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the power supply, and also earths the bodies of the various controls, together with the panel on which they are mounted.

And here a word about this panel: included in the catalog components, the panel we show was actually a surplus one from the now obsolete Playmaster 136 amplifier, with the title blacked out and replaced by "PROJECT 250". It has positions for an off-on switch, a 4-channel switch, a pilot light, and an input selector switch, none of which are essential to the present project. If you do decide to use this panel, which is offered as an economy measure, you will have to decide what to do about the extra holes.

The diagram shows how we wired an off-on switch and a pilot light. We used dummy switches in the 4-channel and selector positions. Alternatively, these could be wired as in the Playmaster 136, although this will entail the expense of extra sockets and loudspeakers. If you decide not to fit these extras, the ends of the panel could be trimmed off neatly.

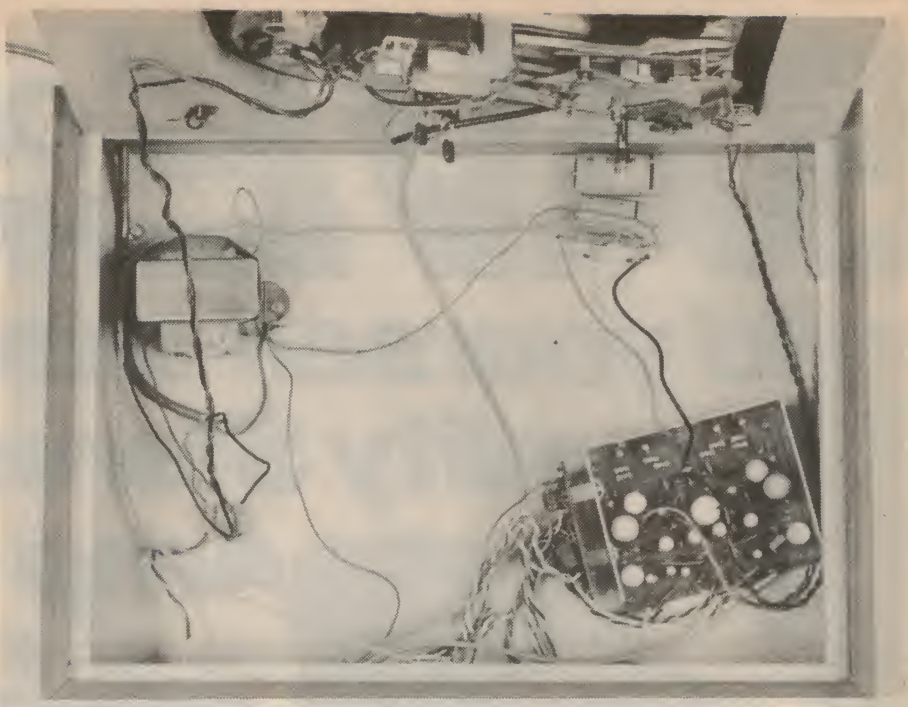
We solved the problem of attaching the panel by simply glueing it in place with Araldite, after cutting clearance holes for the controls in the wooden front panel.

Two wires from the mains must connect to the player motor—just where should be obvious enough on inspection of the motor you plan to use. Be careful with any such wiring, and make sure that nothing can come adrift or short against other components.

In most production type players the fine, flexible leads from the pickup arm are brought out to a tagstrip, more or less as depicted. There is usually an extra lead (shown dotted) to earth the pickup arm, and links between the centre lug and one lead of each stereo pair. When the figure-8 shielded connection is made, as shown, to the volume control (or to an input selector switch) the braid effectively earths the pickup arm, the frame of the player and one side of each stereo input to the amplifier.

An important point is the connection of 0.068uF capacitors across each half of the cartridge. This is essential to allow the cartridge to be used with the 50k volume control specified for the amplifier. The value specified is a good compromise. A larger value would give more prominent bass, but at the expense of pickup output; lower values would give more signal level, but the sound would be progressively more "thin".

In our original review of the power module, we suggested the use of a power transformer rated at 21.5V and 1A—a figure that applied to a particular local transformer then available. As currently supplied, the kit contains a somewhat larger imported multi-tap transformer and the most obvious choice is the 20V tap, which still gave the requisite 30V DC output. In the absence of manufacturer's data, we suggest that you do not go significantly above this figure.



Looking inside the player, with the motor tilted up. The amplifier module is at lower right, power transformer at centre left.

The power supply components can be mounted on a tagstrip or tagboard; layout is not critical, provided all the correct electrical connections are made. We suggest a 2500uF filter capacitor with a nominal working voltage of not less than 35. If your kit turns up with a 1000uF capacitor wire it in and it will work well enough. However, an extra 2500uF capacitor bought and wired in parallel will minimise power supply hum.

Before mounting the amplifier module, sort out and identify all the relevant wires, as shown on the diagram. Some of these are twisted pairs (shown with asterisks), some have single colours and others have two colours. You should be able to sort them out without too much trouble. The two shielded cables attached to the front of the PCB have their shields trimmed back and are then connected as shown in the insert.

A figure-8 shielded pair for connection to the volume control, the three wires to the balance control, and the four leads to the loudspeaker sockets can be attached to the module, which can now be mounted in the case, using a single screw as in the diagram. Then the wires to the controls can be connected, as well as the leads to the power supply and the speakers.

The module should be positioned as far away from the power transformer, motor and mains wiring as possible. Tuck the connecting wires down against the baseboard, and close to the earthed potentiometer bodies. This will help to minimise the effects of the magnetic field radiated from the motor and transformer. If necessary, individual leads can be altered in length to ensure a better layout.

As mentioned earlier, two plug and socket pairs are required for the loudspeaker connections. The exact type doesn't matter all that much, provided that they are polarised and that you observe the same polarity convention for both channels.

In the same way, observe the same convention when you wire the loudspeakers, with a particular connection going to a particular pin on each plug. It doesn't really matter which way round the loudspeakers are connected to the amplifier as long as both channels are wired the same.

Most loudspeaker systems, these days, are fitted with polarised sockets or plugs, or colour coded leads. If not, the speakers themselves usually have a paint spot or a coloured washer to distinguish a particular voice coil connection. If there is nothing else to guide you, brush the speaker leads across an ordinary 1.5V torch cell and note the polarity which causes the cone to move forward in the housing as the circuit is made. Mark the lead which is touching the positive of the battery as "plus" or "active". To be uniformly conventional, wire the system so that this lead connects to the "active" amplifier output, shown as the round pin in the diagram.

And that is about the end of the story. At this point, the record player should be ready for a long and happy life, with no more than an occasional replacement stylus and, in some players, a spot of oil on the spindle and idler bearings.

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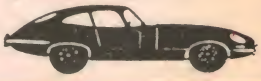

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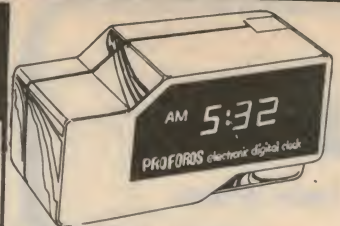

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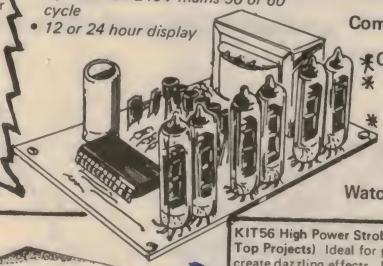

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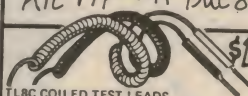

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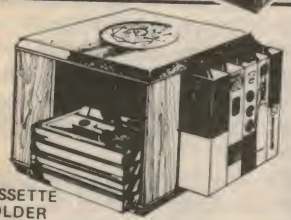

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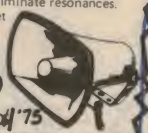

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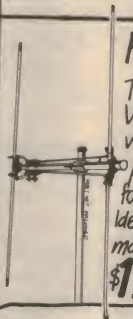

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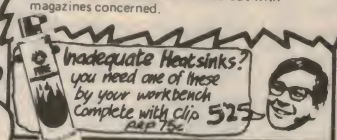

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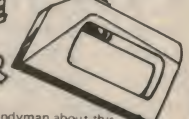

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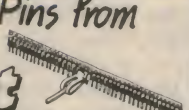

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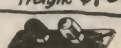

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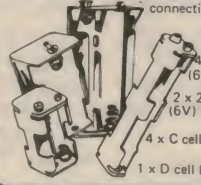

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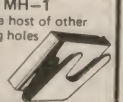

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Forum

Conducted by Neville Williams

AM sidebands: a mathematical fiction?

One of the oldest of all arguments in the world of wireless is that to do with the alleged generation of sidebands when a transmitter is modulated. Do sidebands exist at all or are they a piece of mathematical fiction? If sidebands do exist, can we manage without them? So run the arguments.

The subject was revived recently by a letter from a reader in Western Australia. To be sure, he didn't personally raise all the questions that are traditionally the basis for argument, but they came up anyway when the discussion got loose within our technical staff—a mixture of "oldies" who had heard it all before and "young'uns" who had never had to justify their automatic acceptance of what the textbooks now say.

Lest this statement should seem to be a rather strange one, let me emphasise that arguments about the existence of sidebands were very common at one time, with literature supporting both points of view and with some of the pioneers going to the eternal reward, still ignoring or denying sideband theory.

Here's the letter:

Dear Sir,

Perhaps you could help me with the following query: When an RF signal Fc is modulated by a low frequency signal Fm, thus varying the amplitude of the RF signal, two sidebands are generated, namely Fc+m and Fc−m. These contain the modulated information also.

My query: Why not suppress the two sidebands? Surely all the information is contained in Fc. Thus, a receiver tuned precisely to Fc would receive the carrier and resolve it by responding to the amplitude of Fc at any instant. What then is the use of single sideband?

G.E. (Tuart Hill, WA)

As I said, the letter doesn't spell out all the hoary old questions but they emerge as soon as one starts to discuss the subject. I know they do, because they did: In our office a few weeks back!

The accepted theory of amplitude modulation runs something like this: When modulation occurs in a transmitter, at least four frequencies are present in the output: the original carrier frequency,

the original (audio) modulating frequency, the sum of the two and the difference. Because the modulated stage works into an RF load, the audio component is not sustained but the other three frequencies are, being equivalent to the original carrier and a pair of sidebands, displaced either side of the carrier by a frequency difference equal to the original audio component.

Modulation with a single tone occurs rarely in practice—mainly during test transmissions or when the station is transmitting the time signal. At other times, modulation is by speech or music, resulting in a complex array of sidebands. But, whatever the situation, the composite signal—carrier plus sidebands—is ultimately accepted by the receiver and processed to recover the desired audio component.

So much for the capsule summary.

By convention, what takes place in a transmitter is defined as "modulation". In a non-linear audio amplifier, the interaction of two or more frequencies is more commonly (and curiously) referred to as "intermodulation" while, in a receiver, it turns up as a "heterodyne" or a "beat". Though quite different in context, all these phenomena are basically similar in that they produce sum and difference products in addition to the input frequencies. We are therefore not talking about a unique situation.

But let's get back to amplitude modulation, as such.

Given half a chance, those mathematically inclined will come up with a row of symbols which indicate very clearly (to them) the nature and amplitude of the modulation products in a transmitter. They will point to components in the expanded expression and say: "there's your carrier, constant and unvarying; there's your upper sideband and there's your lower sideband."

Q.E.D. Point proven. We can all go home!

To be sure, it looks very neat and tidy. And it certainly fits in with modern practical applications where one can filter out the carrier and/or one of the sidebands and still resolve the modulation in a distant receiver, provided the receiver supplies a locally generated signal of suitable amplitude and phase to substitute for the missing carrier.

But, leaving aside these relatively modern extensions of amplitude modulation, what seems obvious and transparent to someone who thinks in brackets and squiggles is not necessarily so to others who rely more heavily on mental models.

And let's face it: if you have a single frequency signal, determined perhaps by a very stable crystal oscillator, and you change its amplitude, it does not follow that there are any frequency implications at all. What if you just wind down the oscillator voltage very slowly? Would that produce sidebands? And if not, why should modulation at a higher frequency do so?

That is the way the no-sideband exponents used to argue. Maybe they still do, just as there are some who still support the flat-earth theory!

At first glance, one might assume that they could be shot down in flames by simply referring to the effect of sharply tuned circuits at the output of an AM transmitter or the input of an AM receiver. As the bandwidth is decreased progressively, the higher frequency modulation disappears first, as the outer sidebands are suppressed—seemingly a simple proof of their existence.

But there is an answer for that one.

The no-sideband champions point out that tuned circuits or filters exhibiting a progressively narrower passband, by implication exhibit progressively higher "Q". As such, they exhibit a progressively higher "flywheel" effect, resisting short-term changes in the oscillatory voltage and therefore short-term changes in amplitude occasioned by higher frequency modulation. Who needs the sideband theory?

In presenting the argument, they can

be thoroughly convinced, and with good reason—essentially they are not wrong!

While they might not admit it, they are describing in their own way the same phenomena that the mathematician is describing with his symbols. And while the former group finds difficulty with the sideband aspect of modulation, it isn't hard to find mathematicians who have never gone past their formulas; to whom the alternative thought pattern has never occurred: bandwidth, Q, flywheel effect, resistance to amplitude change.

Curiously enough, argument is likely to unearth yet another type of thinker who is very much at home with graphical representation. Such a person may well construct three sine waves on a sheet of paper, the carrier and two sidebands, each appropriately displaced in frequency. By now plotting the instantaneous arithmetic sum of the three, he can come up with a classic amplitude modulated wave.

Nor is the idea of summing the carrier and sideband components a mere graphical exercise. It happens as a matter of course in physical circuitry because of the fact that individual points in the circuit can only be at one potential at one time, and this has to be the instantaneous resultant of all the individual input components.

While tedious, the graphical method probably illustrates better than any other that the concepts are simply alternative ways of describing the same phenomenon; they are not mutually exclusive.

As an extension of all this, it is interesting to consider what happens when an amplitude modulated wave passes through, say, a diode detector.

It is possible to regard the process mathematically as the recombination or intermodulation of three RF components which reach the detector input. All of the products of this process which fall in the RF spectrum are suppressed by the RF bypassing, leaving intact the one component that is sought: an audio component, equivalent to the original modulation.

But, to take an alternative point of view, it might logically be argued that the diode cannot be at several potentials at the same instant; it can only be at one potential which is the instantaneous sum of all the RF components. Therefore the diode input voltage follows a pattern which is as plotted by the aforesaid graphics expert—a modulated wave. When this is rectified, then integrated by the low-pass filter, the audio component emerges.

On the surface, the two statements appear to be entirely different but the fact is that they are both correct. They simply describe the one situation from two quite different points of view.

Having said all this, the answer to G.E.'s specific question is not hard to find, and it can be answered using a range of concepts.

Considered in isolation, the carrier

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10 MHz ADVANCE OS250 Dual Trace Oscilloscope

BRIEF SPECIFICATIONS

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Display Modes: **Single Trace** Y1 and Y2. **Dual Trace** chopped or alternate modes, automatically selected on timebase switch. Chop rate approx. 250kHz. **X-Y mode** with Y1 input giving X deflection and Y2 input giving Y deflection. Bandwidth DC to 500 kHz $< 3°$ phase shift at 200 kHz.

Horizontal Deflection. **Timebase**—1 μs/cm to 0.5 s/cm in 18 ranges (1-2-5) sequences. **X Expansion** —X10 pull switch gives fastest speed of 100 ns/cm. Variable control gives $>$ 2.5:1 reduction in sweep speed.

Trigger: Variable level control with option of bright line in absence of signal. **Source** Internal Y1 + or —
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component from an ordinary amplitude modulated transmitter is constant, irrespective of the modulation. The extra energy contained in the sidebands comes either from the modulator or by varying the conversion efficiency of the modulated stage. But, since the carrier component is constant, it contains no information, and there is no point in trying to isolate it.

But, even if it did contain information (!) tuned circuits having an extremely high effective Q would be necessary to isolate it from the sidebands and "flywheel" effect would smooth out all but the lowest modulation components. In practical terms, have you ever tried to resolve an AM signal through a peaked crystal filter sitting on the carrier frequency? Whether you prefer "sidebands" or "flywheels", you'd have to admit to the problem!

If I might skip back a few paragraphs, I remarked that there were no self-evident frequency implications when only the amplitude of a rock-steady carrier is changed. In fact, it is possible to provide a peg for a mental concept with the aid of a simple diagram, as in Fig. 1a.

The solid line represents a normal sine wave, ostensibly one cycle of the carrier. If we do anything to produce a progressive reduction in amplitude, it will take the form shown dotted. Inasmuch as the dotted wave departs from the pure sinoidal form, it must represent distortion and the production of frequency components additional to the original. Whether the amplitude is changed by a large amount or almost imperceptibly is a matter of degree. It doesn't alter the basic fact that the wave has been distorted and additional components must have been generated in the process.

Having made the point in simple terms that amplitude modulation does involve distortion of the basic carrier and the production of other frequency components, it is not quite so difficult to concede to mathematicians the job of defining those components.

Nor is it quite so difficult to appreciate that even pure CW Morse code transmissions must involve bandwidth—sometimes more than is bargained for! If the carrier is stopped and started abruptly, it is equivalent to full modulation with a square wave of low frequency but rich in harmonics. The result is a carrier with sideband components that spread, and spread, to be heard in nearby receivers as "key clicks all over the band". When filtering is added to slow up the attack and decay, a situation approaching that depicted in Fig. 1a is created, with a bunch of sidebands during each time interval when the carrier amplitude is changing.

I had just about reached this point in the article when a second letter arrived from the same correspondent, G.E. of Tuart Hill, WA. He had obviously been poring over the maths in the meantime and had something like this to say: (We paraphrase to save space and to avoid the necessity for diagrams.)

Dear Sir,

Recently I wrote to you asking if you could explain the necessity to transmit the sidebands of an amplitude modulated signal. I have since realised from the maths that they are needed.

However, would sidebands be involved if a carrier was modulated with rectangular pulses in phase with the carrier; that is to say, changes in amplitude would be initiated only at the zero crossing point of the carrier? Each segment of the carrier would thus be a train of pure, unmodulated sine waves.

No, I'm afraid that wouldn't beat the system. If you look again at Fig. 1a, that happens to be the way we drew it. But it really doesn't matter where the change is effected in a waveform. If it departs from a pure sine progression, distortion must be present, indicating the generation of additional frequency components.

An interesting sidelight to all this has to do with frequency modulation. As with AM, the presence of carrier "distortion" and the generation of additional frequency components can be inferred from a simple diagram as in Fig. 1b. It so happens that a similar diagram is shown in the well known "Electronics and Radio Engineering" by F. E. Terman. It indicates that, if the time scale of a sine wave is progressively and alternatively compressed and stretched, the waveform must depart from the original pure sinoidal form.

Once again, we can leave it to the mathematicians to define the additional frequencies as a pattern of sidebands, which happen to be quite different and distinct from those produced by amplitude modulation.

However, as distinct from AM, frequency modulation does have the effect of diverting power from the effective carrier component into the sidebands so that, by implication, there must be a modulation-dependent component in the residual carrier. Perhaps G.E.'s original idea of utilising only the carrier would work with FM!

However, even that is not to be. The interplay of carrier amplitude and sideband components is a complex and ambiguous function of both the modulation amplitude and frequency. Therefore, considered alone, the audio component on the apparent carrier is highly distorted—a fact that is borne out by any attempt to resolve FM with an AM receiver tuned to the centre of an FM transmission.

And there, I am afraid, matters must rest for the time being. If we we want to resolve AM and FM transmissions, we still have to resort to established techniques.

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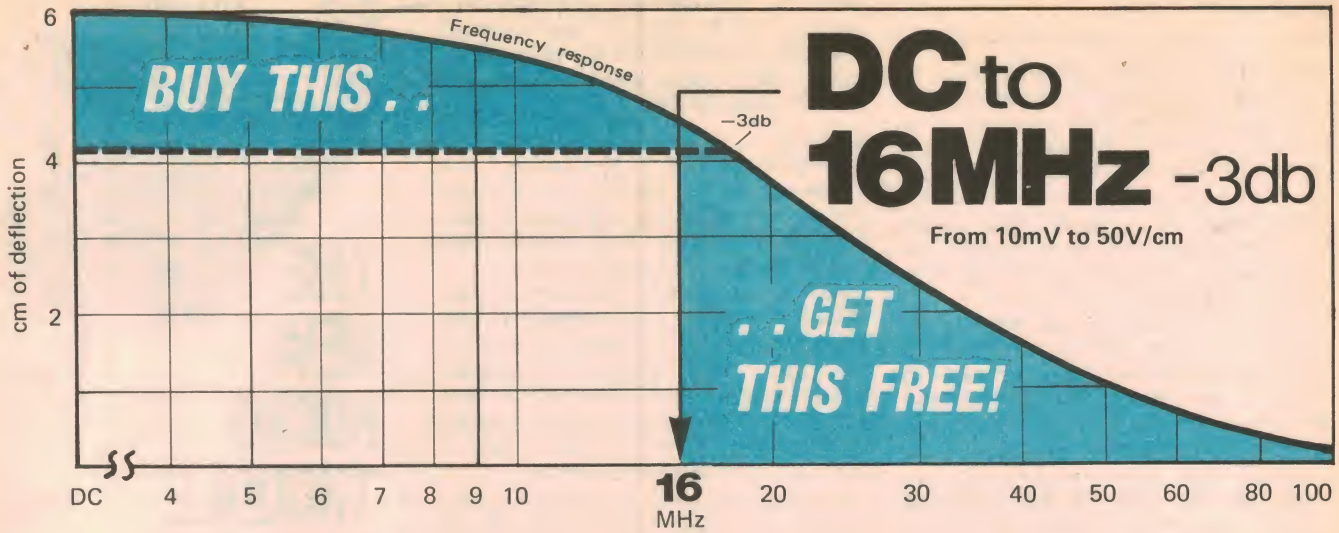

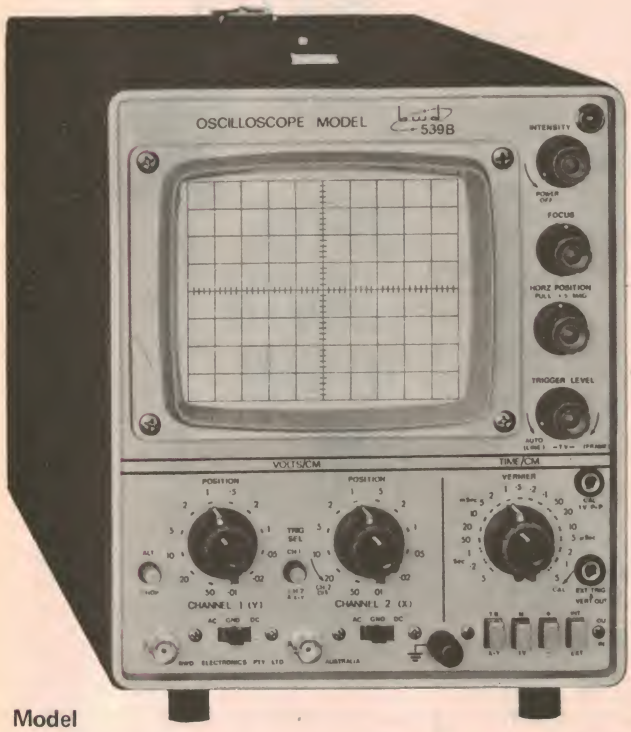

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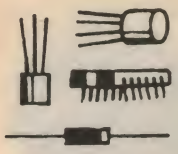


What's new in Solid State

One-chip video IF for colour & mono

Back in the February issue, you may recall, we gave brief details of a new family of seven ICs for PAL colour TV receivers, released by the Italian firm SGS-ATES. In the following month we gave more information on the TDA1190 sound IF, detector and audio amplifier device.

Now further information has arrived from SGS-ATES, this time concerning the video IF-detector-AGC device type TDA440.

Probably the most impressive thing about the device is that the one chip does so much. It provides not only the IF amplifier gain block, but also a synchronous video detector, video preamp with both positive and negative polarity outputs, and keyed and gated AGC. All in one 16-pin DIL package!

As you can see from the circuit at right, it needs a bare minimum of external parts to form a complete video IF and detector module for either colour or monochrome sets. Most of the external components are for the filter block, required to produce the required IF passband.

Performance in the circuit shown is very impressive. The overall gain, including the filter, is typically 86dB, with an AGC range of 55dB and intermodulation products –55dB down over the whole AGC range with chroma carrier level at –6dB and sound carrier at –24dB compared to the vision carrier. Video output variation over a 50dB input range is 2dB maximum. Video bandwidth of the device is 8MHz minimum.

The tuner AGC output of the device may be easily adapted for use with tuners using either NPN or PNP transistor RF stages, or PIN diode attenuators.

Use of the synchronous detector gives the TDA440 very good linearity, and is also responsible for the low intermodulation distortion.

In short, a device which should be of considerable interest to designers of both monochrome and colour TV sets, whether professional or amateur.

SGS-ATES devices are marketed in Australia by Warburton Franki Pty Ltd, with branches in most states.

The next item this month is a device which is almost a "half-brother" to the XR-2240 binary timer which Greg Swain described in an article in September last year. It is another Exar device, with the type number XR-2250.

Like the earlier device, the XR-2250 is a programmable timer rather like the familiar 555 device but with its own internal multi-stage digital counter. However whereas the XR-2240 has a pure-binary counter, the new device has a counter arranged for two-digit BCD counting.

By simple external switching, its timing period may be varied from 1 to 99 times the basic RC product, in unit steps. The total timing range extends from less than 10us to about 24 hours, while two devices may be cascaded for delays of up to 6 months. With two devices, the timing range can be adjusted from 1 to 9999 times RC, again in unit steps.

Maximum frequency of the oscillator in the XR-2250 is typically 130kHz, with a guaranteed 100kHz. It operates from supplies of 4.5 to 15V DC, and comes in a 16-pin DIL package.

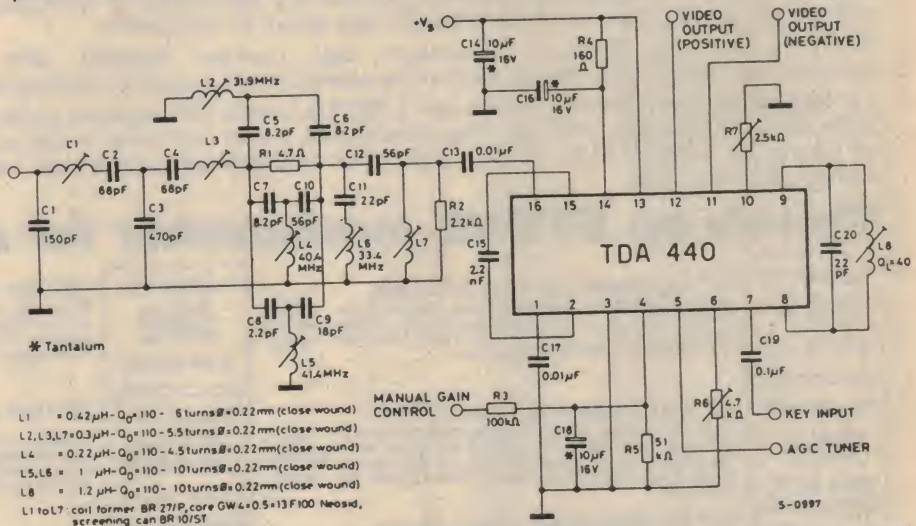
Apart from applications in decimal-programmed timers for process control, it would also lend itself to use in sequential controllers, pattern generation and frequency sythesis.

Another new Exar device is the XR-2216, described as an analog compressor-expander. This has apparently been designed mainly for telecommunications systems, but it may have application in other areas—such as cassette tape recording.

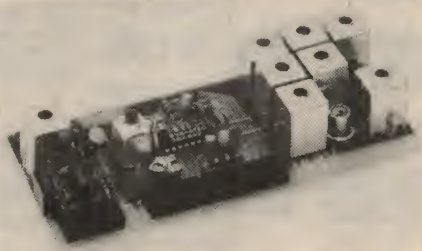
The XR-2216 is intended to work in 600 ohm systems as either a compressor or an expander, depending upon the external connections. As a compressor, it produces an output which varies only 1dB for every 2dB variation in input. As an expander it reverses this operation, producing an output which varies 2dB for every 1dB input variation.

The device will accept input signals within a 60dB dynamic range as a compressor, and within a 30dB range as an expander. Maximum output as an expander is 0dBm into 600 ohms.

Features of the device are low external component count, excellent transfer function tracking, controlled attack and decay times, low noise and distortion and low power supply drain.



Above is the manufacturer's suggested circuit for the TD440 video IF chip, with a sample strip shown at left.



The XR-2216 operates from a supply of 6 to 20V DC, and comes in a 16-pin DIL package. Agents for Exar devices are A. J. Ferguson Pty Ltd, of 29 Devlin St, Ryde, NSW.

The final item this month is news that there is now a second source of 400V SCRs in the TO-92 moulded plastic pack. The US manufacturer Unitrode has recently extended its TO-92 SCR range to 400V, with the addition of device type IP106. Rated at 0.8A average, it features a turn-on time of 0.1us and high sensitivity: gate trigger current is 200uA.

100-piece price of the 400V device is 68c each, excluding sales tax. Agents are Cema Distributors Pty Ltd, 21 Chandos St, Crows Nest, NSW 2065. (J.R.)

For further data on devices mentioned above, write on company letterhead to the firms or agents quoted. But devices should be obtained or ordered through your usual parts stockist.

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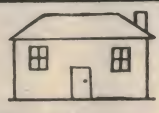

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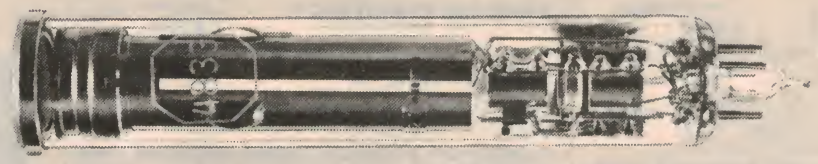

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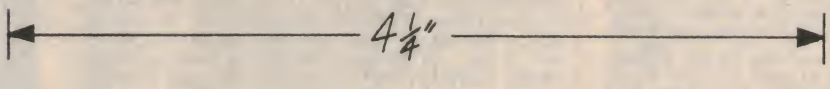

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AD42

Interfacing EDUC-8 to teleprinters & mag. tape

To conclude the description of his basic EDUC-8 microcomputer system, the author presents here a design for a flexible receiver-transmitter circuit capable of interfacing the computer with asynchronous peripheral devices such as teleprinters. Full details are given for interfacing with typical teleprinters, together with details of a simple system for magnetic tape recording using an elementary "modem"

by JAMIESON ROWE

No description of a computer system designed for educational work would be complete without at least a brief look at asynchronous interfacing. Apart from any other reasons, there is the very practical one that in most schools, colleges and universities the peripheral device most likely to be available for interfacing is the familiar teleprinter or "Teletype" (the latter name is a trademark).

I realise that for the individual private constructor, the interest in teleprinter interfacing is likely to be more theoretical than practical, as teleprinter machines are neither plentiful nor cheap. Brand new machines of the most appropriate 8-bit ASCII coded type cost anywhere from about $850 to $1500, depending upon options. Even secondhand machines in moderate condition tend to cost upwards of $200, and they are not available very often.

Second-hand machines using the older 5-bit Baudot or Murray code are available slightly more frequently, and for a more reasonable cost. However while these can be interfaced with the computer, they are less attractive than the 8-bit ASCII type because of the need to arrange for code conversion.

Happily there is a second and quite practical application of the asynchronous interfacing technique, which should be well within the grasp of the individual constructor. Most people have a tape recorder, of either the reel-to-reel or cassette variety, and by using the asynchronous interface with a simple frequency-shift "modem" to be described, such recorders may be used for convenient storage of both programs and data.

But even if you don't have access to a teleprinter, nor feel disposed to build up the circuit for magnetic tape interfacing, I hope the discussion of asynchronous interfacing will prove interesting and worthwhile background information. It is after all an important area within the broad spectrum of computer interfacing, and as such is worth knowing about.

To begin, then. With all of the peripheral devices described so far, although the flag signals which initiate information transfer are generally not fixed in time relationship with respect to the computer's clock pulses, the actual transfer operation itself is always controlled by and locked to the clock pulses. In that sense they may be regarded as "synchronous" peripherals.

Inevitably, there arise situations where one wishes to interface a computer to devices which by their very nature do not lend themselves to this sort of synchronous transfer. Broadly speaking, the devices concerned are designed to transfer information at their own fixed speed, which cannot readily be altered to synchronise with the computer. Probably the most common such device is the teleprinter machine.

Developed around 1906 as an improvement on the simple Morse key and sounder telegraph system, the teleprinter machine has a keyboard and printer mechanism resembling a typewriter. However unlike a typewriter the two are not connected permanently together; they are functionally separated, and share a common case purely for convenience.

In the simplest possible telegraphy system using teleprinters, the keyboard of the machine at one end of the line is connected electrically to the printer of the machine at the other end, and vice-versa. However as this doesn't allow each operator to see what they have transmitted, the connections are usually arranged so that each printer is also able to monitor or "echo" the information sent by its own keyboard.

Being designed for telegraphy, teleprinters are on-off or digital devices. And as they were developed for use over two-wire lines (or single wire and earth), they transfer the information in serial digital form. Each character is sent and received as a sequence of bits, with the number of bits per character and their transmission rate being fixed for a given type of machine and system.

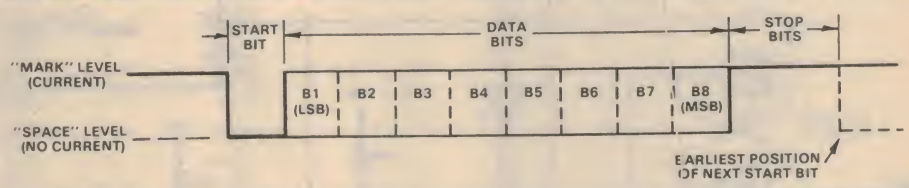
Each character bit sequence has a fixed "start" bit, to identify the beginning of the character. This is followed by from 5 to 8 "data" bits, representing the actual character itself encoded in one of a number of codes. Finally there are one or more fixed "stop" bits, to identify the end of the character sequence.

The character bit sequences are generated at the teleprinter keyboard by a rotary commutator switch, known as the "transmitter distributor". This has a number of fixed contact segments, one for each of the total number of bits in the character sequence, and a rotating brush contact driven by a fixed-speed motor via a clutch. The rotating brush is connected to a power supply, generally a constant-current type designed to deliver either 20 or 60 mA.

With no key pressed, the clutch is disengaged, and the distributor remains stationary. The brush contact touches a commutator segment permanently connected to the output line, so that the line receives current. This is known as the idle or "mark" condition.

When a key is pressed, a mechanical encoding system first operates a number of fixed switches. These open or close the connections between each of the various "data bit" segments of the commutator and the output line, setting up the coding of the character to be sent. Then the drive clutch is engaged, whereupon the motor rotates the distributor through one revolution. As it rotates, the brush contact effectively "scans" the various segments.

After leaving its idle position, the brush first contacts a segment which is permanently open circuit. This breaks the line circuit, to generate a no-current or "space" bit at the start of every character—i.e., the start bit. Then the brush scans the data bit segments, in each case making (mark) or breaking (space) the line circuit depending upon the coding set up for the character concerned. Finally the brush contacts one or more segments which are permanently connected to the line, to generate one or more mark bits—the stop bits.



The serial data format used by 8-bit ASCII teleprinters, showing the way that the start and stop bits are appended.

At the end of the cycle the clutch disengages to bring the distributor to a halt, with the brush still in contact with the last stop bit segment. The machine thus stops with the line circuit made once more—i.e., in the mark condition.

The basic format of a teleprinter transmitted character thus consists of a start bit, a number of data bits, and a number of stop bits, where the start bit is always a "space" (no current), and the stop bit or bits are always "marks" (current). Many computer-type teleprinters use 8 data bits and 2 stop bits, giving the format shown in the small diagram.

The printer mechanism of the receiving teleprinter uses a similar technique to the keyboard in order to produce printed characters from the incoming serial bit sequences. There is again a rotating assembly driven via a clutch from a constant-speed motor, but in this case it is a set of selector cams which control the actuation of mechanical decoding linkages from an electromagnet. The electromagnet, known as the "selector magnet", is also used to control the driving clutch.

The signalling current flowing in the line is used to energise the selector magnet, and accordingly the magnet remains energised while ever the transmitting teletype is idling. In this situation the printer clutch is held disen-

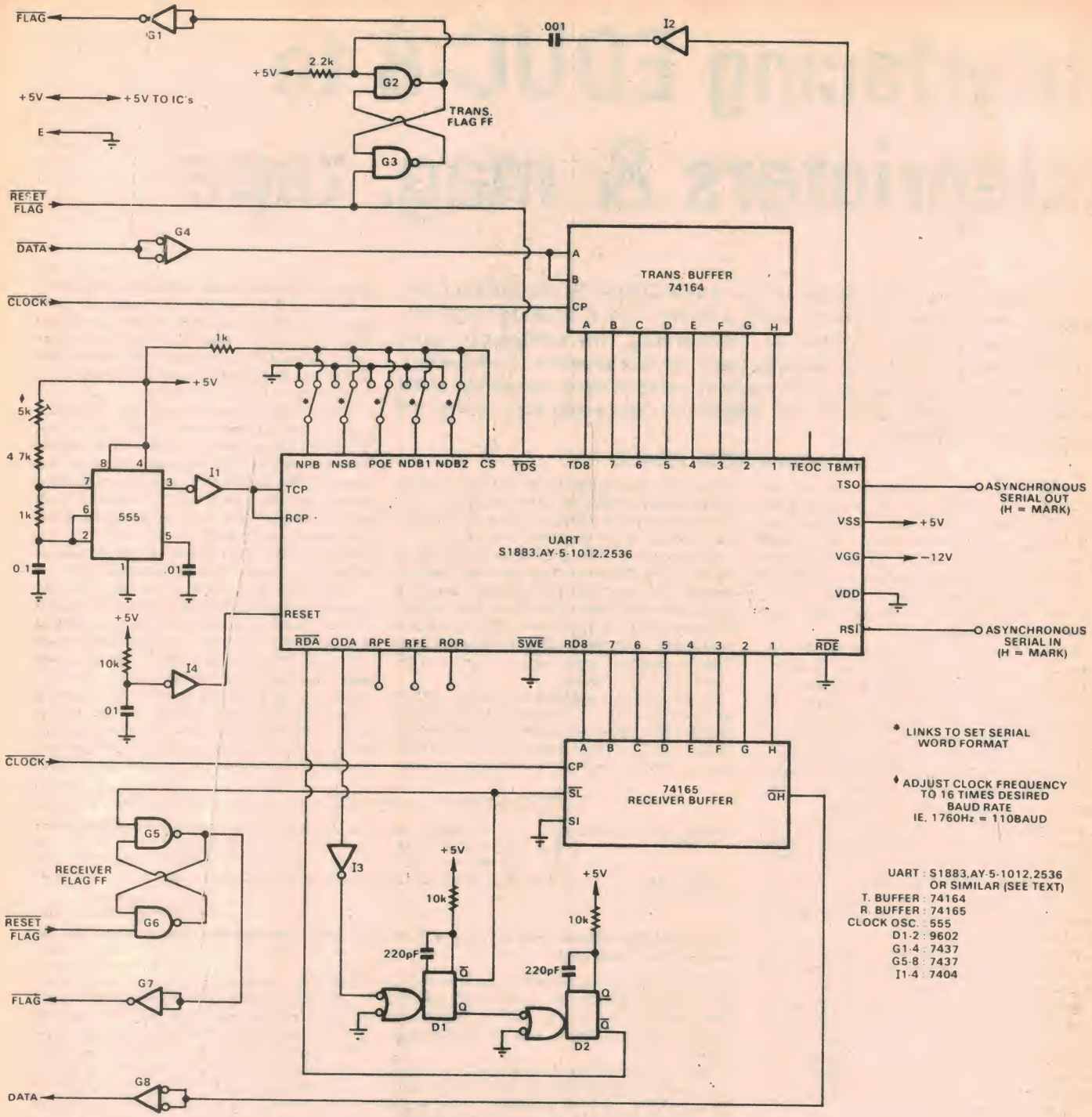


FIG. 1 ASYNCHRONOUS SERIAL INTERFACE

gaged by the magnet, and the printer does not operate.

As soon as a character begins to be transmitted, the line current is broken for the duration of the start bit. This causes the printer selector magnet to release, allowing the clutch to engage. The selector cams begin to rotate, from their rest position. As they rotate, they allow their corresponding printer mechanism decoding linkages to be actuated by the selector magnet, if it is energised, at the appropriate instants during the cycle (corresponding to the various data bits).

At the end of the last data bit, the printer decoding linkages have thus been set up according to the coding of the transmitted character. A further linkage actuated by the selector magnet at the beginning of the stop bit (or first stop bit, if there are more than one), is then used to activate the printing mechanism and print the character. At the same time the energised selector magnet disengages the selector cam clutch, to end the cycle.

As you can see, the system relies upon the motors of both machines rotating their respective mechanisms at identical speeds. Angular synchronism is achieved by having fixed idling positions, and by having the printer "triggered" into synchronism with the transmitted character by the action of the start bit in causing the selector magnet to engage the clutch.

There are basically two problems to be solved in order to interface a teleprinter machine with a computer. The first and simpler is that the machine can only transfer information serially, and at a fixed speed, which is generally much lower than the computer clock rate.

Thus most 8-bit ASCII coded teleprinters intended for use with computers are designed to run at a speed corresponding to 110 bits per second, or 110 baud. As there are a total of 11 bits used per character, this corresponds to a maximum of 10 characters per second.

Machines designed for the older 5-bit system generally run even slower, at 50 baud. In most cases these machines use a stop bit of 1.5 times the duration of the other bits, which is loosely termed "1.5 stop bits". This gives an effective 7.5 bits per character, or a maximum of 6.66 characters per second at 50 baud.

Although it involves a certain amount of fiddling, the low speed requirement is not too much of a problem. So that providing the charactors may be encoded appropriately, augmented with the required start and stop bits, and sent at the correct low speed, it is really not too difficult to drive a teleprinter printing

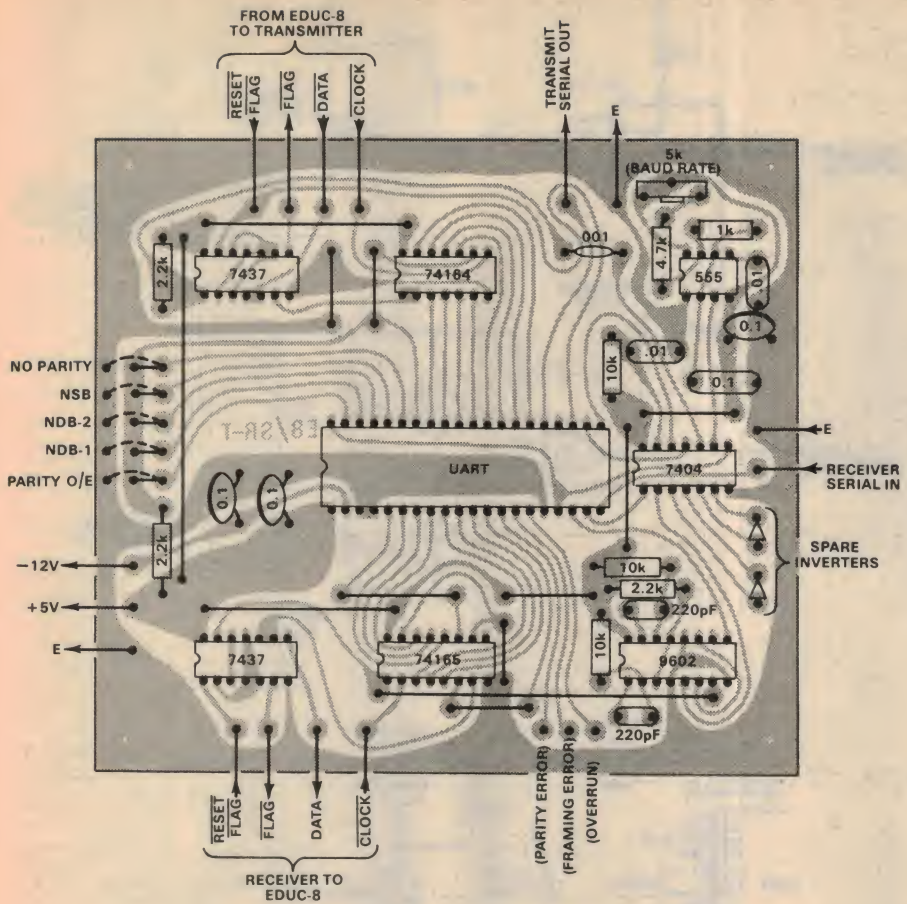


FIG. 2 ASYNCHRONOUS INTERFACE PCB WIRING

mechanism from a computer. As the printing mechanism is already designed to automatically synchronise with incoming characters, it will operate normally.

However it is when one comes to consider using the teleprinter keyboard to send characters to the computer that the second problem arises. This is because the keyboard cannot be synchronised with the computer; it sends each character bit sequence at its own rate, and immediately following a keystroke.

What is needed for keyboard interfacing is therefore a logic circuit capable of electrically-duplicating the operation of the teleprinter selector mechanism—one which is able to recognise the arrival of a start bit, and synchronise with it to strobe in the following data bits.

This is by no means an easy task, as a few moments' reflection may reveal. Until a few years ago, teleprinter keyboard interfacing thus involved quite a lot of complex circuitry.

Happily there are now available single LSI integrated circuits which take care of the whole operation of interfacing with asynchronous devices like teleprinters—both the transmitting and receiving sides. They are called "universal asynchronous receiver-transmitters", or "UARTs" for short. The word "universal" is used because the devices are arranged to be programmable in terms of the number of data bits, stop bits, baud rate, and so on, to suit a wide variety of teleprinters and other devices.

UARTs generally come in an impressive 40-pin dual-in-line package, and considering their complexity they come surprisingly cheap—around $8-10. This seems to be because they are used in large quantities in the data communications industry.

As you can see from Fig. 1, a UART is used as the heart of the asynchronous interfacing unit I have developed for the EDUC-8 system. And using such a device, the interface becomes deceptively simple and straightforward. There are three alternative UART devices which may be used: the American Microsystems S1883 (available from Cema Distributors), the General Instrument Microelectronics Ay-5-1012 (from General Electronic Services), and the Signetics 2536 (from Tecnico Electronics).

Strictly the three devices are not quite identical, because the S1883 is capable of being programmed for "1.5" stop bits, in addition to the single and double stop bit programming provided on the other two devices. However this is really only an academic difference, as it only affects the maximum rate of character transmission when working with 5-bit teleprinters. All three devices will work with such machines, as well as with most others, and thus for all practical purposes they may be regarded as identical.

We don't have the space here to analyse the operation of a UART in detail, and if you are interested I suggest you try and get hold of a data sheet and applications brochure from one of the distributors. However if you bear in mind the foregoing description of teleprinter operation, the general idea should become clear to you as we look at the circuit of Fig. 1.

The transmitter and receiver sections of the UART both need a source of external clock signals, at a frequency of 16 times the desired baud rate. Thus for normal 110 baud teleprinters, the required clock rate is 1760Hz. As you can see, this is provided by a simple pulse generator using a 555 timer IC. The 5k preset pot is used to set the frequency to produce the exact baud rate required. The values of the pot, its series resistor and the 0.1uF charging capacitor may all be changed, if necessary, to adapt the interface to baud rates very much higher or lower than the nominal 110 baud rate shown.

A single set of logic inputs are used to program both the transmitter and receiver sections of the UART for the serial word format required. The inputs are those marked NPB (no parity bit), NSB (number of stop bits), POE (parity odd/even), NDB1 and NDB2 (both used for setting the number of data bits). These are taken to either the high or low logic level to program the device for the format required.

For our purposes, the most appropriate format is words having 8 data bits, no parity, and 2 stop bits. This is very suitable for handling both instruction and data words from EDUC-8, and is also the format used on many 110 baud teleprinters. As it happens, this format is programmed by taking all five of the UART logic inputs to the logic high level, as shown.

Probably the only other format you are likely to want is that for 5-bit teleprinters, which use 5 data bits, no parity, and "1.5" stop bits. To program the UART for this format, simply take the NDB1 and NDB2 inputs down to low level, leaving the others at high level. Strictly only the S1883 device will give the correct "1.5" stop bits, but the other devices will still give satisfactory operation.

The UART transmitter section has 8 parallel inputs for the data bits to be transmitted, labelled TD1-8. To provide these with the data word to be transmitted, the interface uses a 74164 device as a buffer. The word is shifted into the buffer serially, at the computer clock rate, as with the other output devices which have been described.

The word is actually loaded into the UART's internal data buffer from the 74164 by the RESET FLAG (L) pulse from the computer, which is fed not only to the transmitter flag FF, but to the TDS-bar (transmit data strobe) input of the UART. This input not only causes the word to be fed into the UART, but also triggers the transmitter circuitry to begin transmitting it. Accordingly the UART adds the start bit and stop bits required, and feeds the word out of the TSO (tramsmit serial out) terminal, at the correct baud rate.

When the last data bit has been transmitted, the UART signals that a new number may be loaded for transmission, by producing a high logic level at its TBMT (transmitter buffer empty) output. This signal is fed through inverter I2, and used to set the transmitter flag FF via the .001uF differentiating capacitor. The flag FF is formed by gates G2 and G3, with G1 used as a buffer for the FLAG (L) line to the computer.

When the UART sets the flag FF to signal that the last data bit of the current word has been transmitted, the stop bits still have to be transmitted. Thus the computer has a time period equivalent to two bits at the asynchronous rate—i.e., about 18 milliseconds at 110 baud—in which to feed the next number into the 74164 buffer. The computer can thus keep up with the UART quite easily, and cause characters to be sent at the maximum character rate, if desired.

The receiver side of the UART accepts the asynchronous serial input at its RSI (receiver serial input) terminal. When a character arrives at this terminal, the receiver circuitry automatically detects its start bit, synchronises with it, and strobes the following data bits into an internal buffer. It then indicates that a received word is available at its eight parallel outputs RDI-8, by producing a logic high level at its ODA (output data available) output.

The external receiver interfacing circuitry inverts this signal through inverter I3, and uses it to trigger a monostable, D1. The output from D1 is a narrow pulse (about 1us), and is used

to load the data from the UART outputs into the external receiver buffer register, formed by a 74165 device. The pulse is also used to set the receiver flag FF, formed by gates G5 and G6. Gate G7 is used as before to provide buffering for the FLAG (L) line.

The output of monostable D1 is also fed to a second monostable D2, whose output is a second 1 us pulse immediately following the first. This is used to reset the UART's internal receiver flag circuitry, readying it for the arrival of another character.

When the receiver flag FF is set, the computer is thus made aware that a character has been received and is ready for transfer in the receiver buffer. It can then transfer the character into the AC register as with any other input device, by supplying clock pulses and receiving the data via the line driver G8.

Note that the UART requires both 5V and —12V power supplies, being a MOS device. The 5V supply comes from the computer, and is used to power the other interface ICs as well. The —12V supply involves only about 40mA, and is provided by a small supply in the interface unit itself. Inverter I4 and its associated R-C network are used to reset various internal UART circuitry when the power is first applied.

To make it easier for you to build up the basic asynchronous interfacing circuit of Fig. 1, I have designed a small PC board for the job. It is coded E8/SR-T, and the wiring for the board is shown in Fig. 2. As you can see, links are provided to allow the unit to be programmed for various word formats.

Incidentally, you probably realised it anyway, but just in case you haven't I should perhaps point out that the interface connects to two of the EDUC-8 input/output ports. The transmitter section connects to one of the output ports (OD0 or OD1), while the receiver connects to one of the input ports (ID0 or ID1). This is because it is really two peripheral devices in one—or more correctly, it "interprets" for two.

The TSO and RSI terminals of the UART are not designed to connect directly to a teleprinter line. In fact they are basically standard TTL logic terminals, with the convention such that the logic high level represents the "mark" condition for both, and logic low the "space" level. Both normally remain high when the UART is idling.

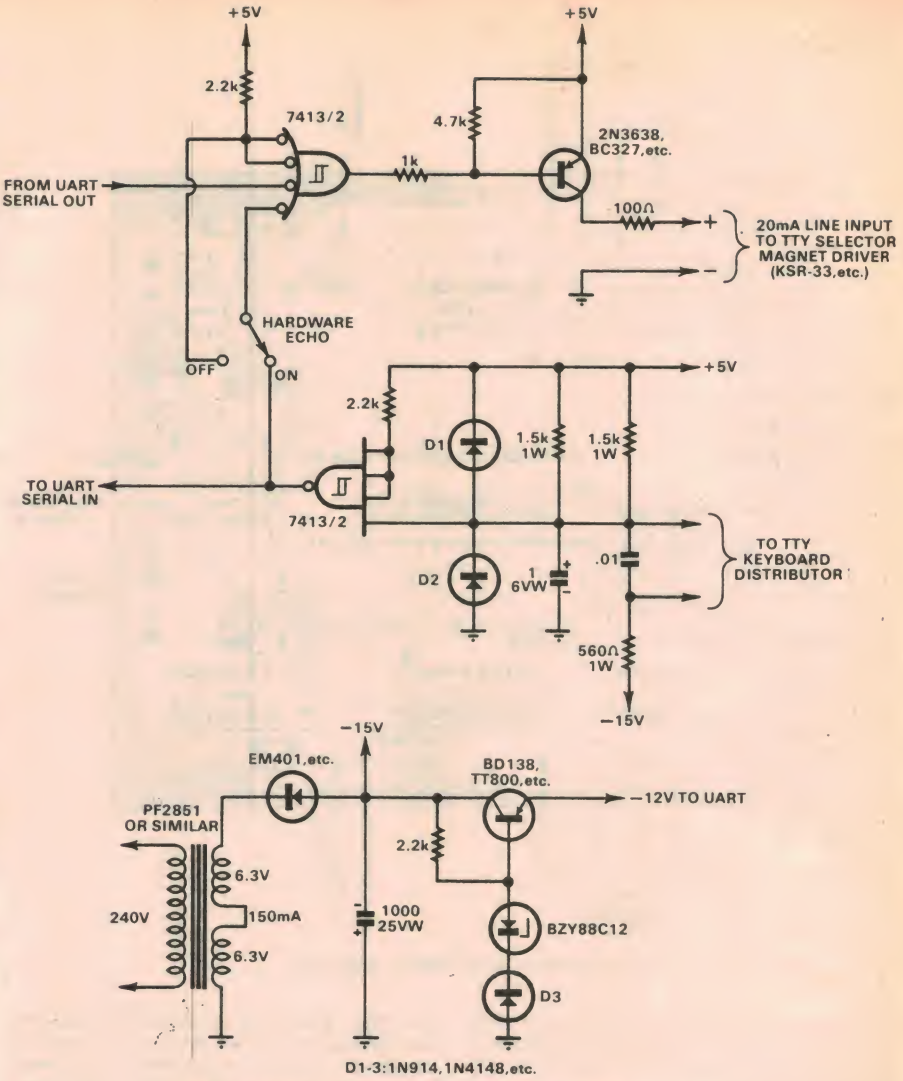


FIG. 3 TELEPRINTER INTERFACING (33 SERIES TELETYPE)

To connect the interface with a typical modern teleprinter like the Teletype series 33 machines (KSR-33 or ASR-33), you will need supplementary circuitry as shown in Fig. 3. This also includes the small power supply required to produce the —12V rail for the UART.

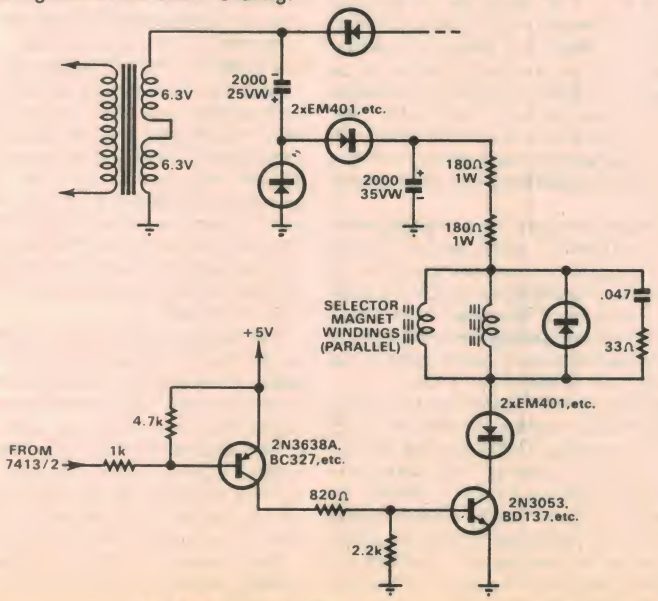


FIG. 4 SELECTOR MAGNET DRIVER FOR OLDER TTYS

The 33 series Teletypes have an internal selector magnet driver circuit, so that the incoming signal line does not drive the magnet coils directly. This simplifies the external circuitry required, as there is no need to worry about inductive spikes, back-EMF, etc. All that is required is a logic inverter and a simple PNP transistor stage, shown at the top of Fig. 3.

Note that as shown, the PNP stage is designed to provide 20mA of signal current into the teleprinter selector magnet driver. This of course assumes that the driver is adjusted to expect this current level, rather than the alternative 60mA level. The changeover from 60mA to 20mA input is quite easily made, if required, by swapping over a link in the driver circuit.

The remaining logic shown in Fig. 3 forms an input shaping and Schmitt trigger circuit to produce a signal from the teleprinter keyboard distributor contacts, suitable for feeding to the UART serial input on the interface PC board. The R-C components and diodes are used to clean up the signal fed to the 7413 Schmitt trigger element, to remove bounce and other spurious transients.

Note that the distributor contact circuit is connected to both the 5V supply rail and to a source of —15V from the small power supply. The resulting 20V swing helps in producing a clean signal from the rotating distributor contacts.

You have probably noticed that the second half of the 7413 Schmitt trigger device is used

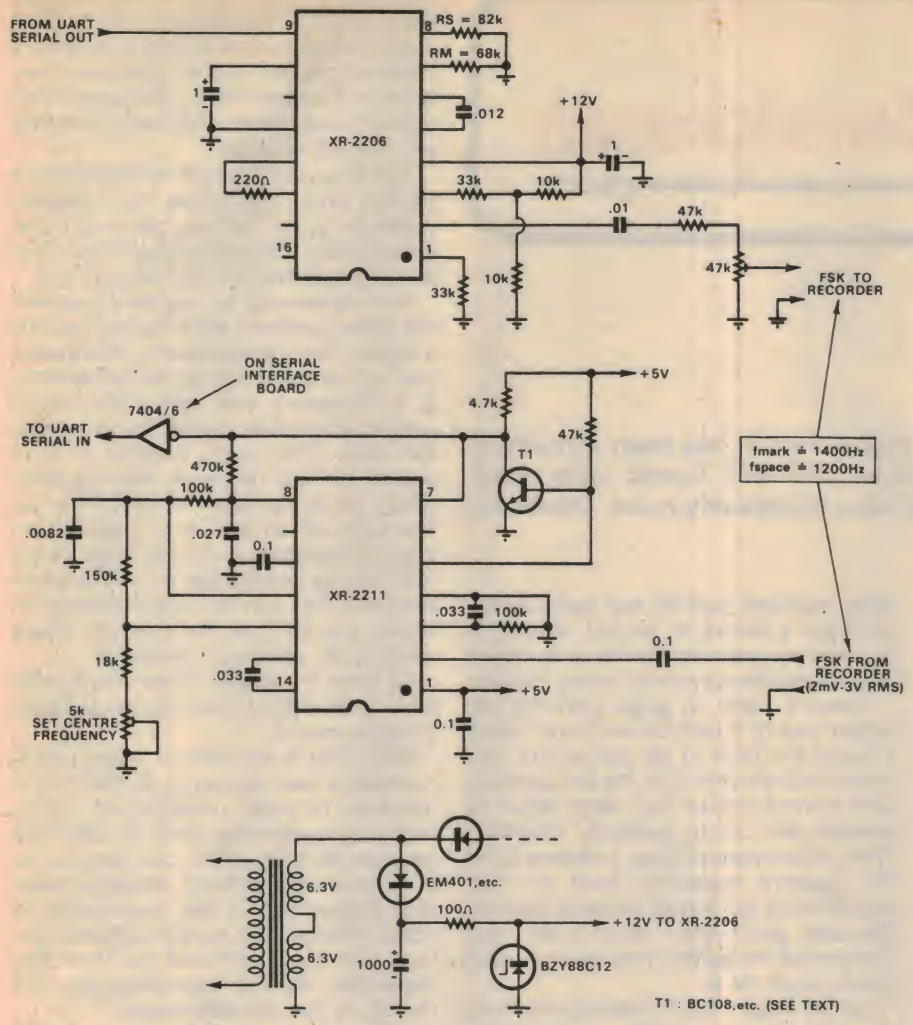


FIG. 5 MAGNETIC TAPE INTERFACING

as the inverter for the PNP selector driver amplifier. This makes it possible to provide a "hardware echo" facility, so that if desired the printer can be made to automatically echo whatever is transmitted to the computer from the keyboard. As you can see, this is achieved simply by disconnecting one of the spare inputs of the 7413 from logic high, and connecting it instead to the output of the lower 7413 element. The top element thus becomes a negative-input OR gate, feeding signals to the printer from either the UART or the keyboard.

Older teleprinter machines differ from the newest 33-series Teletype machines in that they generally do not have an internal selector magnet driver circuit. In other words, the incoming signal line drives the selector magnet windings directly. The magnet has two windings, which are connected in series for 20mA operation or in parallel for 60mA operation.

To operate one of these older machines with the interface, you will need to modify the circuit of Fig. 3 as shown in Fig. 4. The change mainly involves the addition of a further rectifier circuit to the power supply, to generate about 25V, together with a medium power NPN transistor to switch the selector magnet current.

As you can see, the magnet windings are connected in parallel for 60mA operation, as this gives more reliable operation from a 25V supply. The two 180 ohm resistors are to set the current level, while the two diodes and the R-C circuit associated with the magnet windings are to suppress the inductive back-EMF.

Don't forget that in order to operate an older teleprinter of the 5-bit variety with the EDUC-8 system (or with any other computer, for that matter), you will have to perform code conversion somewhere in the system. This is because 5-bit machines use the Baudot or Murray code, not ASCII.

The code conversion could be done by the computer program itself, but this will of course involve valuable memory space. Perhaps a neater way would be to interpose read-only memory circuitry between the UART data inputs and outputs and the 74164 and 74165 buffers, in the interface circuit of Fig.1. You could use either IC ROMs, or diode arrays.

I hope the foregoing information will enable you to connect up a teleprinter to your EDUC-8 system, if you want to do so, with a fair degree of confidence and success.

As mentioned earlier, the asynchronous interfacing unit of Figs. 1 and 2 may also be used for storing program and data on magnetic tape. Before closing, I will give a brief description of how this is done. Almost any mono recorder may be used, of either the cassette or reel-to-reel variety.

As with a teleprinter, it is not all that difficult to transfer information from the computer to magnetic tape—providing the transfer is made at a suitable rate, in this case one which will fall within the modest bandwidth of an audio recorder. The problems tend to occur in the reverse transfer direction: from the tape back to the computer. Like the teleprinter, a tape recorder tends to supply information at its own fixed rate, and cannot be synchronised readily with the computer clock pulses.

Happily the same asynchronous data format used for teleprinters may be used for tape recording and playback—all that is needed is to encode the data in audio tones, so that the recorder is not required to handle DC levels.

The most reliable results are obtained using the technique of frequency-shift keying, or "FSK", where the two digital data levels are recorded as tones of differing pitch. This means that the tape is always recorded with a tone of one pitch or the other, which allows the effects of drop-out to be minimised.

Generating and demodulating FSK signals used to be a fairly complex business, but thanks to modern IC technology it is now fairly straightforward. As shown in Fig. 5, only two ICs and a transistor are required in order to adapt the basic asynchronous interface circuit of Fig. 1 for magnetic tape recording.

Both of the ICs are made by the Exar Corporation, and are available in Australia from A. J. Ferguson Pty Ltd (order through your usual supplier). They are the XR-2206 waveform generator device, and the XR-2211 tone and FSKdetector device. Each costs around $5.00.

The XR-2206 device is designed to produce either square, triangular or sine waveforms over a wide frequency range, and has the additional feature that its frequency may be switched between two values by a TTL logic signal applied to pin 9. Here it is used to generate sine waves of either 1400Hz or 1200Hz, with the higher frequency corresponding to "mark" and the lower to "space". The signal from the TSO output of the UART is fed to pin 9 to produce the required FSK signal, which appears at pin 2 of the device. This is fed to the recorder via a preset pot, to adjust recording level.

To decode the FSK signals on playback, the output from the recorder is fed to the XR-2211 device. This device is especially designed for FSK demodulation, and works on the phase-locked loop principle. It will lock onto input signals anywhere between 2mV and 3V RMS, so that the output from the recorder can vary over a very wide range without causing a data error.

The XR-2211 device has two outputs, a tone-detect (L) output which appears at pin 5, and the actual FSK demodulation output which appears at pin 7. By wiring transistor T1 as shown, the output from the device remains low when there is no incoming tone—i.e., when the tape is stopped. By using one of the spare inverters on the interface board, this low is changed to a high, so that the RSI input of the UART receives the correct "mark" signal whenever a character is not actually being played back from the tape.

As soon as the tape is started and tone appears, the level at pin 5 of the XR-2211 falls to the low logic level, and transistor T1 turns off. However the level at pin 7 will still be low whilever the tone from the tape is at the "mark" frequency. It will only go high when the tone changes to the "space" frequency, and the inverter will thus feed the correct logic levels to the UART.

For correct operation the VCO of the XR-2211 must be set to give a free-running frequency midway between the incoming mark and space frequencies—i.e., 1300Hz in this case. This is set by means of the 5k preset pot in series with the 18k resistor, connected to pin 12.

You can perform this adjustment reasonably well by recording a section of tape with a single character repeated, and monitoring the output signal going to the RSI input of the UART with an oscilloscope. Then adjust the 5k pot while playing back the tape, until you are getting a clean, noise-free signal.

(Continued on page 107)

That first colour fault

C-Day has come and gone and, for many of us, it has been something of an anticlimax. Far from being inundated with frantic calls about obscure colour faults, the scene has been deceptively quiet. Doubtless it is only a lull before the storm.

I have not encountered any worthwhile colour TV faults as yet, probably because most sets are under warranty and their owners hesitate to seek outside help. I was rather interested, therefore, when a letter from a country colleague told a very interesting story about a minor C-Day emergency which was overcome by a combination of good old fashioned country cooperation and a spot of keen observation on my colleague's part.

Here is his story.

Well; colour television is with us, and whether we like it or not we—as TV servicemen—will have to service colour sets or eventually go out of business. At first glance, the problems involved appear to be quite formidable—but are they? I recall the early days of monochrome TV and the problems that then seemed insurmountable, but which to-day are just routine. This could very well be the situation a year or so from now. As technicians gain more experience in servicing colour sets the average service job should not take any longer than a monochrome repair. In addition the present use of modular construction will greatly assist the technician, as will the easy accessibility of modern sets. Both will be significant time savers.

As you have no doubt guessed, these thoughts were prompted by my first colour TV repair job. It started with a phone call on the Friday afternoon before C-Day, the customer stating that his new colour set was losing colour intermittently. I had serviced his old black and white set on several occasions, but it had reached a stage where it was no longer economical to repair, so he decided to trade it in on a colour set.

He had contacted the service company who had contracted to repair the set under warranty but, unfortunately, they could not do anything about it until the following Monday, due to the number of service calls listed for that day. I told the customer to bring it round and I would see what I could do. Meanwhile I rang the manager of the service company involved, and he was quite agreeable that I attend to the set. In fact he thanked me and said that his firm would re-imburse the set owner for my charges.

When I came to grips with the set, which was of a well known local make, I found the fault to be just as the customer had described it; the set came on with normal colour but, after about 10 minutes the colour suddenly vanished. Then, a few minutes later, it returned and this pattern repeated itself in what appeared to be a quite random fashion. The only good point about it was that it occurred frequently enough to enable me to work on it.

At this stage I tried to decide the best place to start. I mentally ruled out the deflection and picture tube control circuits, also the front end, luminance, and synch circuits, as the set appeared to be working normally in monochrome. So my thoughts turned to the chroma circuits—chroma bandpass amplifiers, burst gate sub-carrier oscillator, etc, and I was contemplating a long search with the CRO and the VTVM for the elusive component.

However, before diving in—boots and all—I took another look at the picture—and here I got my first clue. I noticed that, as well as lacking colour, the picture was not as sharp as it should be, also the trouble seemed worse on the high channels than on Channel 2. I tried adjusting the fine tuning control, but found I couldn't tune into the sound bars or the colour pattern. To prove the point I let the set run until the colour reappeared and again tried fine tuning. This time everything was normal. So that was it—a shifting tuner oscillator.

Access to the tuner was quite easy. By removing the nameplate from the front of the cabinet and undoing two captive screws at the top, the whole control panel swung down to allow convergence adjustment and also gave access to the tuner. I carefully removed the tuner from its mountings and removed the rotor, which gave me access to the oscillator transistor, a BF183. As it seemed the most likely cause of the drifting, I removed it. Luckily I had a replacement in stock and I wasted no time in fitting the new transistor and re-assembling the tuner in the control head. I then switched on and the set worked normally.

I let it run for a couple of hours before closing time, and when the customer called for it, he was very pleased. I telephoned him about a fortnight later, and he reported that the set was still OK.

It is interesting to consider just why the tuner oscillator shift had caused this trouble. The chrominance information and colour burst signals are transmitted at a frequency just below the sound carrier. If the fine tuning is too far into the video, little or no chroma or burst signals will be received. Among other things the burst signal holds off the colour killer circuit and, once it falls below a predetermined level, the killer circuit will remove any vestige of colour which remains. This can be demonstrated by tuning any set too far into the video, causing the colour to disappear.

So there it is chaps—a job which could have been difficult—but turned out quite straightforward.

Well, that is my friend's story. I think it contains two lessons; one that it is all too easy to panic unnecessarily in the face of an unfamiliar fault in unfamiliar equipment, but which can turn out to be something relatively straightforward. And lesson two is the importance of observation; in this case the observation that the monochrome picture was degraded, thereby providing the vital clue as to the possible cause.

Still on the subject of colour servicing, and ways in which this can be done more effectively and more economically, I was interested to read recently of a new approach to the problem by the Grundig company of Germany.

Like most manufacturers, Grundig has long favoured the modular construction in which a large part of the set is built around plug-in modules. When a fault occurs the serviceman has only to identify the faulty module—rather than the individual component—and replace it.

But what of those portions of the set which do not lend themselves to this technique? Grundig have tackled this by developing a diagnostic adaptor, which provides an instant check of the non-modular circuits.

According to the English magazine "Practical Electronics" for January this year, it works as follows:

"Key check points of the circuits are all brought to a single 13-way socket into which the service engineer plugs his monitor. The monitor has 13 LEDs and, if any one of these fails to light, there is an indiction of a specific fault.

"It costs very little extra on each set to provide the facility and the saving in engineer's time can be enormous. And, of course, with soaring labour costs time saved is very important, not to mention customer satisfaction. The plug-in diag-

nostic aid costs the dealer under £10. Quite a bargain. And the customer benefits, too. Other set makers are expected to follow the trend."

By the way, did you notice the reference to "service engineers"? How about that!

Seriously though, I believe the broad concept has a lot of merit. Nor is it really anything new, having been used in commercial communication systems, to a greater or lesser extent, for many years. Perhaps it's time we caught up.

Meanwhile, half baked and otherwise doubtful technical statements about colour TV continue to appear in the daily press and various lay journals. It is small wonder if the man in the street is confused.

From the magazine "Crosstalk", the official journal of the Boomerang Tape Recording Club, comes this gem.

"A television expert has condemned the 'consistent rubbishing' of imported colour TV sets. He is Mr K. Parkin, a senior TV technician, who claims that some Australian made sets are inferior to their foreign rivals. Mr Parkin, who works for a commercial television station, said there were misunderstandings about imported sets.

"He referred to the conflict between the PAL D and PAL bypass systems used in colour sets and said, 'if both sets are adjusted correctly, there will be no difference in the picture quality.'

"Mr Parkin said Australian sets did not have auto fine tuning. 'The fine tuning affects the colour drastically,' he said. 'Our station gets hundreds of calls when colour programs are on—all saying there is no colour. When the callers are told to adjust the fine tuning, the problem is usually cured.'

"Mr Parkin advised new set owners how to go about the tuning operation. 'A lot of people say this should be done with the colour off, then bring up the colour. It's possible that when they turn up the colour, they see none.' He said that sets should be adjusted to maximum colour with minimum noise. 'All imported sets have auto fine tuning, so do not suffer this problem', Mr Parkin said Mr Parkin said imported sets could be moved around a room without upsetting reception—which could not be done with Australian sets.

"He said an imported tube cost $100 and a local one $240."

Assuming that the gentleman has been quoted correctly, there would seem to be several statements which are doubtful, to say the least.

Granted, there is no point in "rubbishing" imported sets simply because they pose a threat to the local industry, unpleasant though that may be. By the same token, there seems to be little point in rubbishing the local product unless the criticisms can be substantiated.

First the statement that the bypass PAL system is capable of giving the same results as the PAL D system, assuming both are adjusted correctly.

As I understand it, the bypass PAL system virtually converts PAL signals to NTSC signals as far as that particular set is concerned. On that basis, all the admitted problems inherent in the NTSC system—and which led to the development of PAL—no longer exist (according to Mr Parkin) and the NTSC system is capable of the same standard of performance, in all circumstances, as the PAL system. I'm sure those countries using NTSC will be glad to learn that all the problems they believed they had, don't really exist!

Second: Australian sets do not have auto fine tuning. Well, I can think of one, right off; the Rank Arena. There could be others. As for the importance of this feature, this is debatable. If users are unable to get colour signals because they do not know how to use the fine tuning control, then the dealer who sold and installed the set has fallen down on his job and/or the user is too lazy to read the instruction manual.

In any case, most sets feature a memory type fine tuning system so that, if the installing technician had set the fine tuning for each channel correctly, the user would hardly be aware of the problem.

The final part of this criticism says: "All imported sets have auto fine tuning." Well, I can recall the data sheets of at least two imported sets which make no mention of this feature. In one case I have seen the set itself and could find no such feature. So perhaps we could say "some", or even "most", but not "all".

Third: Imported sets can be moved around the room without upsetting reception—which cannot be done with Australian sets.

Again, a very sweeping statement which might be hard to substantiate. In fact, there is no reason why imported sets should be any better or worse in this respect than the local sets since the problem, to the extent that it exists at all, is a fundamental one. It is true that certain types of picture tube, such as the Trinitron and the vertical slit tubes in general, are less critical in regard to convergence and, therefore, less prone to orientation problems.

But these tubes are being used in SOME overseas sets and SOME Australian made sets, so any attempt to distinguish them by the country of origin is rather pointless.

Fourth: An imported tube costs $100 and a local one $240.

I was not aware that any locally made colour tubes were available. I may be wrong of course but, if I am, I am in good company. None of the local set manufacturers seem to know anything about them either!

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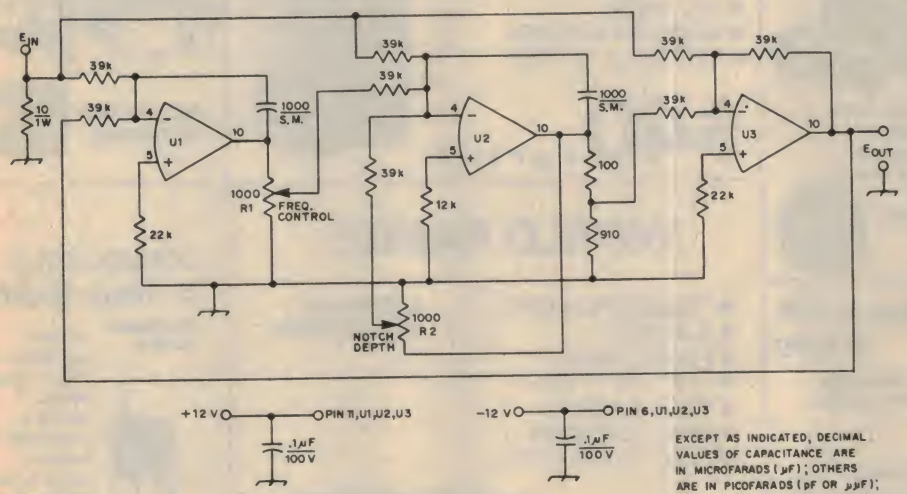
085.P.421

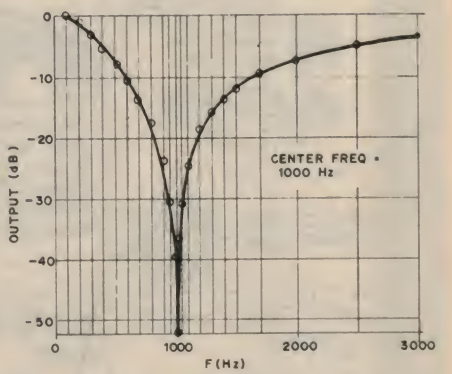
Circuit & Design Ideas

Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Analog-computer-type active filter





The advent of low-cost operational amplifiers in the past few years has excited interest in their use in RC active filter circuits. Instead of using one operational amplifier and an RC input-feedback network configuration with some inherent shortcomings, it is possible to use three op-amp networks to achieve virtually any second-order transfer function. Let us recall that op-amps received their name originally because analog computers used amplifiers of high gain and wide bandwidth to perform mathematical operations such as integration and summation. A wide variety of differential equations may be solved in this manner.

One interesting application is the synthesis of transfer functions using one or more op amps. A good example of what can be done is a notch filter using three op amps. Centre frequency can be varied (using one control) up to approximately 4kHz, with circuit Q and notch depth remaining practically constant over the range. Component matching is not required. Only one setup adjustment is needed, a variable control adjusted for best notch depth.

In the circuit shown, U1 and U2 serve as integrators with a DC gain of about 25000. U3 serves as a summing device. The 1000 ohm control R2, is used as the Q control and is adjusted only once for deepest notch. R1 serves as the frequency control by controlling the "gain" of the differential equation, which the system is solving in effect. For easiest tuning, this should be a ten-turn precision type potentiometer.

The results are impressive for a circuit of such simplicity. Notch depth is at least 50dB. Measurement of absolute depth was difficult because the test oscillator used had a harmonic content suppressed by only 50dB. Notch depth remains approximately constant over the tuning range, with Q seeming to increase somewhat with centre frequency. In determining experimentally the plot, the Q control was untouched.

In operation, the input to the filter may be taken from the speaker or headphone jack of a receiver. Because a 741 op amp will deliver approximately 12V peak-to-peak across 2000 ohms, a high impedance headset may be connected directly across the output. A suitable buffer stage could be added to drive a low impedance speaker or headset.

Best results in notching out an offending heterodyne can be achieved when the receiver AGC is turned off. Otherwise, the strongly interfering carrier would heavily activate the AGC and reduce the receiver gain, pulling the desired signal down with it. This filter would be a useful accessory for an ordinary SSB transceiver, which normally lacks provision for IF notching. In my setup, I am able to take the required voltages for the filter from the VOX accessory socket of the Swan 350.

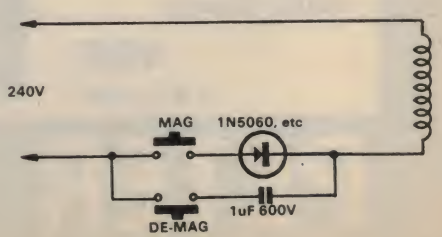
The preferable tolerance of the 39k resistors is 2 per cent. All others can be 10 per cent. Tolerance of the silver mica capacitors should be 5 per cent. U1, U2 and U3 are type 741 op amps. Pin numbers are shown for 14-pin DIL package. (Motorola MC1741L or MC1741P2.)

(By Allen Taflove, WA9JLV, in "QST".)

Simple magnetiser or demagnetiser

A magnetised screwdriver can be useful for fishing a steel nut out of an inaccessible place, or for holding a nut while screwing it up. Alternatively, a magnetised tool is a menace when adjusting tape-heads or when it becomes covered with iron filings. This simple arrangement for magnetising and demagnetising tools can be very useful. The main item is a field coil of 1000 ohms or so, salvaged from an old loudspeaker. The rest of the circuit is self-explanatory. The tool is inserted into the hole of the field coil and the appropriate button pressed. When magnetising, the coil is fed with pulsating DC. When demagnetising, a capacitor is introduced in series with the coil, producing a strong alternating field. The tool must be withdrawn slowly from the coil while the demagnetising button is held down.

(By Mr G. Leadbeater, 16 Ellison Street, Ringwood, Vic 3134.)



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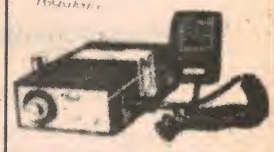

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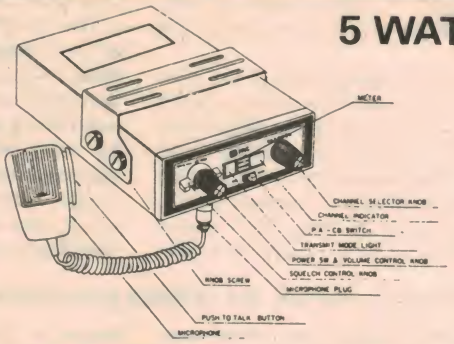

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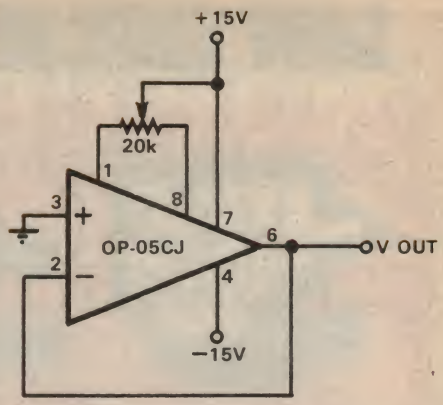
Precision mV source from op amp



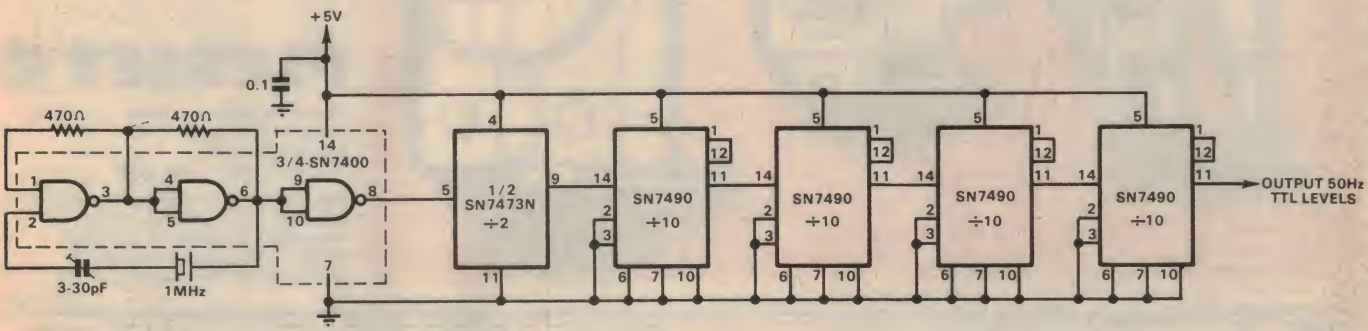
A low output impedance mV source is frequently required in test systems and one can be constructed using only two parts—an instrumentation op-amp and a potentiometer.

The op-amp is connected as a unity gain buffer as shown and the output is adjusted to the required voltage using the offset nulling terminals. The amplifier must have suitable characteristics such as low long-term drift, freedom from chopper and 'popcorn' noise, good power supply rejection and low offset voltage drift with temperature. To achieve low output impedance the device must have high gain around zero output voltages and should have negligible thermal induced drift.

Use of a high performance bipolar input op-amp such as Precision Monolithics mono 05CJ provides the required parameters. With a typical initial offset voltage of 0.3mV, outputs from about −3.5mV to +3.5mV can be achieved.

(From "Electronics Weekly".)

Crystal-derived 50Hz for clocks



This circuit uses only six series 74 TTL ICs constructed on a piece of Veroboard. It needs only one adjustment and due to the use of flip-flops, it always divides by the correct factors.

The crystal oscillator uses three of the four NAND gates of an SN7400 IC. This circuit is suited to crystals in the range 100kHz to 18MHz, series mode. This circuit should lend itself for use with many junk box crystals as well.

The dividers consist of an SN7473 JK flip-flop, followed by four SN7490 decade counters. These divide the 1MHz crystal frequency which I am using, down to 50Hz. By changing the division factor, other crystal frequencies may be used.

The power supply uses an IC regulator, with a 15V centre-tapped transformer, to provide 5V at approximately 125mA. The regulator IC should be mounted on a small heat sink.

For calibration, all that is required is a short-wave receiver capable of tuning to VNG on 4.5MHz, 7.5MHz, or 12MHz. Placing the circuit near the receiver aerial input results in a heterodyne note. This is adjusted for zero beat by means of the 30pF trimmer.

The uses for this frequency standard are left up to the reader's imagination. It is well suited for use with the digital clock described in June, 1973. Alternatively, by feeding the output to an audio amplifier driving a step-up transformer, it may be used with mechanical digital clocks. In such applications requiring a very reliable timekeeper, an emergency power supply should be considered.

(By Mark A. Curtis, 44 Cresthaven Drive, Mansfield, Qld 4122.)

Adding Ge-Si ident to TX-FET checker

One of our most popular test instrument projects was the "Transistor-FET Checker" of August 1971, which was also reprinted in the Projects and Circuits Handbook.

As it stands, the checker is capable of making many useful checks on most common small-signal devices. However one thing it won't do is distinguish between germanium and silicon bipolar transistors. This can be a very handy facility when sorting through oddment devices, or bargain "seconds".

As it happens you can add such a facility quite easily. Simply wire two silicon diodes (1N914 or similar) in inverse parallel, and connect them in series with a small pushbutton switch between the B-G and E-D test terminals.

To identify which type of transistor you have, simply press the extra button when you are reading its gain. If the gain reading drops, it is a silicon transistor.

(By Jamieson Rowe, E-A staff)

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Rank colour sets

We wish to reply to a letter from Mr. R. Hartkopf published in your March issue concerning his Rank Arena colour TV receiver.

The condition he describes, "brightness control rushing up from nothing to full over the last quarter of an inch, the picture blooms and changes focus", is certainly not typical of our CTV receivers.

Our Melbourne Service Department visited Mr. Hartkopf's home to inspect his receiver and found that it was a loan set. Because of the tremendous demand for our product it is not possible to give immediate deliveries and the set was loaned by the retailer pending delivery of Mr. Hartkopf's own receiver. The loan set had not been installed by a technician and needed the usual set-up adjustments. When this was carried out, I am informed, Mr. Hartkopf was completely happy.

With reference to a letter from Mr. P. W. R. Cropley of Strathfield passed on to us for investigation, again our technician visited only to find that it required installation adjustment. This apparently had not been carried out properly on initial installation. Mr. Cropley is now completely satisifed and mentioned he will be purchasing the receiver from the rental company.

We are continuing our comprehensive technical education programme so that all Rank Arena retailers and service personnel are very familiar with our product. Rank Arena has already established a reputation for reliability and picture quality bettered by none and at very reasonable prices.

B. G. Fitzgerald,
National Sales Manager,
RANK ARENA.

FM receiver tuning

The Australian Government has accepted in principle the recommendations of the Commission of Inquiry into FM Broadcasting to establish FM transmissions in the frequency range 88-108 MHz. The Commission has recommended that the televised transmissions operating within this frequency range be progressively transferred to other channels, with Ch. 5 (101-108 MHz) being cleared first, followed after some years by Ch. 4 (94-101 MHz) and at a later date, if necessary, by Ch. 3 (85-92 MHz).

Action is currently being taken to transfer the Newcastle national TV station from Ch. 5 to Ch. 5A to free the band 101-108 MHz for FM transmissions in Sydney and Newcastle. It is therefore clear that the initial development of FM transmissions will be in the 92-94 MHz and 101-108 MHz ranges.

All parties within the industry who are involved in the provision of FM receivers are therefore warned that FM receivers designed for the domestic FM bands in Japan (76-90 MHz) or Western Europe (87.5-104 MHz), examples of which are reported to be on sale in some Australian States, will be unsuitable for reception of the Australian FM transmissions as now licensed or being planned, although receivers designed for the European band to 104 MHz will have limited use, in the early stages when transmissions are confined to 92-94 MHz.

Interested purchasers of FM receivers should be advised that only those covering the whole frequency range 88-108 MHz will provide adequate reception of the developing Australian FM service.

B. J. Connolly, Secretary
Aust. Broadcasting Control Board,
Melbourne.

Last words on cm

In the March issue of Electronics Australia, you again ask what makes it a sin to use centimetres, and why some people are so vehemently against the use of centimetres.

The preferred multiplying prefixes are based on ternary powers of 10, and in electronics the commonly used prefixes extend from pico through nano, micro, milli, kilo, mega to giga. The disputed prefixes which are not ternary powers of 10, namely, centi, deci, deca and hecta. The avoidance of multiplier prefixes which are not ternary powers of 10 and the preference for those which are, is based on:

1. Established usage: Already in many fields particularly electronics, the non-preferred multipliers are not used. How many times in the history of your magazine have the following been used:

Voltage:	cV, dV, daV, hV
Current:	cA, dA, daA, hA
Power:	cW, dW, daW, hW
Frequency:	cHz, dHZ, daHz, hHz
Resistance:	CΩ, dΩ, daΩ, hΩ

If you argue that it is more convenient to say 12cm than 120mm, then surely it is more convenient to say 12cA than 120mA.

2. Avoidance of confusion and ease of reading: A dimension of 900cm can be confused with a dimension of 900mm; for example, at a steel yard you are just as likely to want a piece of steel 900mm long as 900cm long, and the yardman must listen carefully not only to the number part of the size but also to the unit.

Compare this to the situation where the unit of measure is restricted to mm and m; you are unlikely to want a piece of steel 900 m long and the yardman is just as unlikely to be able to give it to you.

There seems to exist in the minds of some people that idea that the use of mm as a unit of length implies a resolution of 1 mm in the measurement. This, of course, is not true; a length stated as 123mm (or 12.3cm) gives little indication of the resolution of the tools used to ascertain the length. If a length is ascertained with low resolution, it can be expressed rounded to the nearest 10, 20, 50, 100 or 200mm, as, for example, "The instrument measures 400mm wide x 150mm high x 200mm deep".

The objections to the use of the cm are made with great vehemence because it is known that once the use of the cm becomes established, it will be impossible to eradicate it.

G. E. Harding,
Mitcham, Vic.

COMMENT: Your letter is the first to attempt to clarify the situation calmly and factually, and we take your point – particularly with reference to avoidance of confusion. This would certainly appear to justify avoidance of the centimetre, and we will endeavour to do so. Other readers please note that correspondence on this subject is now closed.

Distributor name

Over the years we have noticed occasional reference to the AKAI product range being distributed by Maurice Chapman & Co. Pty. Ltd., etc.

Please note that AKAI Australia Pty. Ltd. is a privately owned Australian company and imports and distributes those products manufactured by the AKAI Electric Co. in Japan exclusively.

Any reference to other company names should be avoided in all publications. We also advise that AKAI should at all times be printed in capitals.

Paul M. Graham,
National Sales Manager,
AKAI Australia Pty. Ltd.

Classical Recordings

Reviewed by Julian Russell

Verdi—Rigoletto: "lively and accurate"

VERDI—Rigoletto. Complete opera. Rigoletto (Leonard Warren); Gilda (Erna Berger); Duke (Jan Peerce); Maddelena (Nan Merriman) Sparafucile (Italo Tajo) and others with the Robert Shaw Chorale and the RCA Orchestra conducted by Renato Cellini. RCA Victrola Mono AVM2-0698.

This veteran—it was recorded in 1950—is well worth the reissue. If you readjust your amplifier as I did by cutting the treble and boosting the bass you will be astonished at the quality of the sound. By the way the recording is so forward that you will probably have to reduce your gain, too, from its normal position. The quality is a little on the hard side but is admirably clear—though a little more reverberant than is fashionable nowadays. And it is, of course, in mono though it emerges well from two speakers.

In Act 1 the outstanding performance comes from Jan Peerce as The Duke. As Rigoletto, Leonard Warren is sometimes a little unsteady and not always squarely in the middle of the note. Renato Cellini directs the ensemble firmly but also pays affectionate attention to the many picturesque details of the score. Act 2 opens with a clean attack on the dramatic chords and this tension is maintained throughout. A notable feature is the excellent diction of Warren and Italo Tajo (Sparafucile) in the ensuing duet. Tajo is a fine bass and my only complaint about the recording is that the singers sound so close—though they wouldn't, of course, in an opera house—that their vocal techniques have no mystery. You can actually hear Warren covering his high notes and the cavernous quality that creeps into his low ones. The orchestra is again lively and accurate. Cellini is the sort of conductor of middle period Verdi who interprets as well as accompanies. The big item in this act is Gilda's aria, Care Nome, and Erna Berger sings it enchantingly in a fresh girlish voice which trills as effortlessly as a bird. It was a pity, therefore, that I found the final trill of the area just a trifle flat. But this is easily forgiven when one remembers the pleasure that has been enjoyed earlier.

The Robert Shaw Chorale is wholly admirable in the difficult staccato chorus "Zitti, zitti." Not only do the men point their phrases with the most impressive accuracy, but the orchestra coordinates with them to perfection. In this act I was again disappointed in Warren's performance. There are times when his voice sounds quite unfocussed.

In the last act Peerce makes that now worn-out aria, "La Donna e Mobile" sound spontaneous. By the way it may be new to some readers to learn that Verdi did not hand out the parts for this song to either the tenor or orchestra till just before curtain rose at the first performance. He claimed that he didn't want every errand boy in town whistling it before it was heard in the theatre. The old chap knew a winner when he wrote one. The famous quartet comes off fine—and what wonderful music it is. And how nice to hear it for a change without the applause that so often follows it.

The Maddelena (Nan Merriman) is a bit more assertive than usual. No harm in this because she certainly succeeds in making her role sound really tough. Something suddenly happens to the recording perspective when the Duke repeats "La Donna e Mobile" just before he sleeps. And in this act Miss Berger doesn't quite realise all the dramatic potential of her role. And I can quote you an example of 25-year-old realism in the engineering—I'll swear that you actually hear the rain during the storm music. At its reissue price I think this set is quite a bargain. An English/Italian libretto accompanies the boxed set of two discs.

RACHMANINOV—Piano Concerto No. 3 in D Minor. Vladimir Horowitz with the RCA Victor Symphony Orchestra conducted by Fritz Reiner. RCA Victrola Horowitz Collection, Vol. 4. In Mono. VVM1-7035.

Horowitz starts this with a pearly touch quite unlike the steely fingered attack used by the composer. But with Horowitz this comes later where, no matter at what the speed or however forcefully delivered each note is impressively separated from its neighbour. His general performance of the concerto is about as romantic as you're likely to hear from any first class pianist. I am told the composer admired Horowitz immensely though his style was quite different from his own. Did I write that Horowitz style was quite unlike Rachmaninov's steely fingered attack? That was before I heard Horowitz play the final movement of this concerto. And in contrast to this you have the fragile beauty of the little scherzetto interlude introduced about the middle of the first movement.

Having written this about the performance I must now come to the poor quality of the sound. Admittedly it was recorded originally back in 1951, but even by the standards then accepted this was anything but a good example. I am afraid that with the orchestra recorded as faintly as it is you will get only a very little idea of how the work should sound in a concert hall, despite the brilliance of Horowitz' playing. Even when the orchestra gets a good chance to play on its own—in the intro to the second movement—its phrasing is good but the reproduction wan in the extreme.

Nowadays many musicians regard Rachmaninov as a minor follower of the great Tchaikovsky. True his piano concertos suffer from similarity in style and content yet each speaks for itself, sometimes very beautifully and always gratefully for the soloist. Admittedly there are some awful moments—the final page of the C Minor is one. But there is much to enjoy both by high and middle brows in all these pieces. If only the sound had been better I could have recommended this with the same enthusiasm as I did Rigoletto.

★ ★ ★

YELLOW RIVER CONCERTO—Communally arranged. Ilana Vered (piano) with the National Philharmonic Orchestra conducted by Elgar Howarth.
MOZART—Piano Concerto No. 21 in C (K.467) Ilana Vered (piano) with the Royal Philharmonic Orchestra conducted by Lawrence Foster. Decca Phase 4 Stereo PFS4299.

I can praise two features of this strange production—the brilliant engineering of the Phase 4 stereo sound, and on the sleeve the coloured photograph of the horse which was the outstanding exhibit at the exhibition of Chinese antiquities shown in the Petit Palais in Paris when I was there in 1973.

As to the music, I can only describe it as really awful—crude, plagiaristic, vulgar, raucus, slick and everything else bad that you might add to this list. Yet it has a strange fascination, something like that of the cheapest type of provincial circus.

Most of this attraction must be attributed to the sound, which is really astonishing enough to shock even the most case-hardened supporters of stereo. By the way there is no mention of a quadraphonic version so if you have been plugged into buying such equipment don't be misled by the label "Phase 4" against a conspicuous "4" on the record sleeve.

But back to the music. One can imagine without difficulty the approval of the Supreme Soviet or whatever is the name for Chairman Mao's controllers of culture. It's music for the people all right. But for a different kind of people to those who designed that magnificent horse. According to the sleeve notes the work is the Yellow River Cantata by the Western trained composer Hsien Hsing-hai, but was "communally adopted in its present form"—whatever that might mean—by the Central Philharmonic Society. The notes also state that "although the concerto can be listened to purely as a piece of abstract music it does, however, as do all Communist Chinese works of art, contain an official propaganda message, a resume of which follows for those who may be interested." I'll spare you the rest which, as you will probably guess, is a description of a noble-minded proletariat overthrowing its oppressors. Despite all this I would never dream of parting with my pressing. It will be good for a laugh anytime except perhaps among the good Chairman's supporters. The pianist, Ilana Vered, plays with a fluent technique and a plummy tone which, while suitable in this travesty of a piano concerto is quite out of place in the Mozart on the reverse side.

The Mozart is the Concerto No. 21 which was featured in that sickeningly pretty film Elvira Madigan a few years ago. It is cleanly played though hopelessly out of style, a curious mixture of delicately handled strings and woodwind with the brass coming in like that of a military band. The first movement is fairly good, though over-romanticised, but it is the Andante that really infuriates with its nauseous sentimentality. Miss Vered shows enough talent to make one want to hear her in something more suitable to her temperament. Another point—to use Phase 4 to record a Mozart piano concerto is a little like shooting at sparrows with a cannon.

★ ★ ★

TCHAIKOVSKY—Suite from The Sleeping Beauty Ballet. Philadelphia Orchestra conducted by Eugene Ormandy. RCA Red Seal Stereo ARL1-0169.

Under the unpleasant title of Tchaikowsky's Greatest Ballets—I've never heard an inferior one, by the way—the Philadelphia under Ormandy does all that is expected of them. The recording is slightly on the reverberant side and Ormandy's tempos tend sometimes to be a bit slow. As an example listen to the first oboe solo, taken at a pace that makes the spotlighting of the first desk soloists almost an advertisement for the players. But go on a little further and you will be entranced by the richness of the strings followed by a splendidly faithful passage for cymbals and gong. I didn't recognise some of the scoring, especially counter themes and figurations, perhaps because I have forgotten the original. Many of the slow tempos are delivered molto con amore—a characteristic of this sumptuous sounding orchestra. But devotees of the ballet will recognise most of the items from previous recordings, particularly from those which were released under the title of Aurora's Wedding—which in this new issue takes up most of Side 1.

One thing you can bet on with certainty—you'll never hear the music played with such opulence of tone as an accompaniment to the ballet—at any rate in any Western theatre. The suite offered here must be pretty well a complete version of the ballet. At any rate all the important items are included. And I don't think I have to remind any reader of the profusion of exquisite melodies that were set down by Tchaikovsky, one of the world's greatest melodists.

I did find the rhythm of the most famous of the waltzes a little rigid, produced, I think, by the slowish tempo and strict beat. And I have never heard anything more "soulful" than the violin solo at the beginning of Side 2. It seems to pierce right down into the very bowels of compassion. If you love schmaltz of the refined kind this is most certainly for you. The small critical points I have mentioned can easily be forgotten—or forgiven—in the wash of sensuous sound that emerges from the speakers of good equipment.

★ ★ ★

BAROQUE BRASS Pieces, mostly transcriptions played by the London Festival Brass Ensemble directed by Elgar Howarth and Alan Civil. Decca Phase 4 Stereo PFS4290.

No less dazzling sound can be heard in this Phase 4 recording, too, but this time it is used on worthy material. The full title of the disc is The Magnificent Sound of Baroque Brass. And magnificent it is. The title is a little misleading because some of the baroque instruments—sackbuts and cornets, for instance—have been replaced by their modern counterparts. But the result is quite staggering just the same. There are seven items on the disc each worth its own special notice.

The first is Scheidt's Cantus 21: Galliard Battaglia a 5 Voci, played with quite wonderful precision of intonation and quick tonguing. You will hear some nice antiphonal effects with martial flourishes on trumpets from left and right, sometimes in fanfare form, at others in showy little tunes.

No. 2, a Sonata Hora Decima No. 14 by Pezel arr. Wilbraham, consists of a Sonata (Adagio), a Courante and a Sarabande. This is notable not only for the players' admirable fluency but also for changes of timbre in piano and forte passages.

No. 3 is a solemn Fugue in C Sharp Minor by J. S. Bach arranged by Howarth from the first book of the Well-Tempered Clavier. This comes off very well in its transcription for brass. As to the propriety of the transcription—well old Bach himself was an inveterate transcriber of other men's music. After a while the piece begins to show traces of what Sir Thomas Beecham once described as Bach's "Protestant polyphony." But this is too short to really matter.

No. 4 consists of Three Fanfares by Zelenka, even more martial sounding than those in Item 1 because of the addition of drums to the brass. One can easily imagine mounted players in gorgeous uniforms with the drummers waving their sticks in military unison.

No. 5 is a suite by that great innovator of keyboard technique John Bull. This is another transcription by Howarth again brilliantly effective. The Suite consists of a Pavan and Four Variations, and The King's Hunting Jig, the stately Pavan contrasting vividly against the exuberance of the Jig.

No. 6 is a March for Three Trumpets and Timpani by C.P.E. Bach. This again features fanfare-like flourishes, but in the form of dialogues brought off with superb elan.

And finally No. 7 is a Suite by Locke arr. Civil, of Music for His Majesty's Sackbuts and Cornets, here replaced by trombones and trumpets. It belongs to the Restoration Period and was composed to celebrate Charles II's royal procession before his crowning at Westminster. The work is not only beautiful but also daringly innovative in its technique which shows the influence of that great Italian writer for brass, Gabrielli.

The whole disc is an extraordinary exercise in virtuosity both in performance and engineering. I found it all a most stimulating experience.

Lighter Side

Reviews of other recordings

Devotional Records

HE'S GOT THE WHOLE WORLD IN HIS HANDS. Various artists. Stereo, CBS/Reader's Digest 5-record boxed set.

I'll describe this new Reader's Digest set as succinctly as possible and leave it to you to make a decision as to whether it will earn a place in your collection.

Record 1, "Beloved Favourites" features a variety of artists in the 12 tracks, typically: Mahalia Jackson, "He's Got the Whole World"; Frankie Laine, "I Believe"; Rosemary Clooney, "Bless This House"; Jim Nabors, "I Walk With God"; Eydie Gorme, "Climb Every Mountain". Other artists include Johnny Cash, Percy Faith, Roy Hamilton, Robert Goulet and Andre Kostelanetz. One might perhaps describe this first disc as typical middle-of-the-road "commercial" Gospel.

"Gospel Soul" is the theme title of record 2 and, as the title might suggest, it is predominantly negro style, most of the tracks by Mahalia Jackson, broken by contributions from Percy Faith, Johnny Cash, and the Abyssinian Baptist Choir. It won't appeal to everyone.

By contrast, record 3 relates more to the local chapel with hymns like "Amazing Grace" (Patti Page); "It Is No Secret" (Anita Bryant); "Rock Of Ages" (Jim Nabors) and "How Great Thou Art" (Tammy Wynette). There are 12 tracks on this disc also, of this general style.

Record 4 is titled "Country Chapel" and opens with "These Hands" by Johnny Cash. Burl Ives follows with "In The Garden" and then Patti Page with "Abide With Me". Jim Nabors sings "The Old Rugged Cross" and, by this time, the "country" theme seems to be in some doubt. Much of the sound could relate to any chapel, anywhere.

The last record in the set, "Joyful Harmony", features group singing throughout, typically: "The Lord Is My Shepherd" (Mormon Tabernacle Choir); "Go Tell It On The Mountain" (Ray Conniff); "Lead Kindly Light" (Mitch Miller); "Swing Low Sweet Chariot" (King Family); "Jesus, Saviour Pilot Me" (Merrill Staton Singers).

Now to the problem; what kind of Gospel music do you enjoy? If your tastes are conservative, with a question mark over "soul", the Mahalia Jackson style, and the group sound of the Staple Singers, then you'll probably bypass about a third of the tracks. Sure, that will leave 40 possibles but it does change the value-for-money formula.

But, then again, your tastes may be quite catholic (small c) in which case you'll find plenty of diversion in the diverse tracks.

Technically, the sound is normal and the packaging well up to the usual "Reader's Digest" standard.

I've done my best to summarise. Now it's up to you. (W.N.W.)

★ ★ ★

MISA CRIOLLA. Ariel Ramirez. SEVEN SOUTH AMERICAN FOLK SONGS. Los Huanca Hua. World Record Club stereo S/4605.

One of the most interesting records to come my way in the past year, this album of an authentic folk orchestra, Los Huanca Hua, has a setting of the Catholic Mass based on the rhythms and traditions of Latin-American folk-lore on side one and seven South American folk songs on side two.

Misa Criolla (Creole Mass) composed by Ariel Ramirez has a Spanish liturgical text which has been approved by the Church for use in Latin America. The orchestra uses two large drums and native percussion instruments plus guitar and gong. Ramirez has chosen distinctive rhythms, based on popular Latin American dances and folk songs, to convey the religious fervor of each section of the Mass.

Expert in harmony and counterpoint, Los Huanca Hua give a particularly appropriate rendition of the liturgy while at the same time incorporating all the vigour and feeling of the Latin-American character. Anyone interested in music for the modern Catholic liturgy should get hold of this album.

Spanish and English text is supplied for the Mass so you can follow the Spanish version which in many ways is more apt than the English. People who prefer the old Latin Mass will agree with this.

I'm afraid that I found the seven folk songs on side two rather over-shadowed by the Mass but I suppose they are not really out of character since they have similar rhythms. Perhaps it might have been more appropriate to release them on a separate record.

Recording quality is good, although tape hiss does become noticeable when the volume level is high. The recording of the drums during the Mass sequences is some of the heaviest I have heard and sounds very impressive with a moderate amount of bass boost. Altogether a very satisfying album. (L.D.S.)

Instrumental, Vocal and Humour

CONCERT IN BLUE. Various orchestras. Stereo, World Record Club WRC S/5279.

On the classical verge of the popular field, this album contains four major items:

"Warsaw Concerto" (Addinsell); Willi Stech piano, and the Berlin Symphony Orchestra. One of the most popular pieces of film music ever written: a "mini-concerto" from the film "Dangerous Moonlight".

"South Of The Alps" (Fischer); Bavarian State Radio Orchestra. Four-part suite, popular in the days of radio concerts: Harbour Town, Seaside Terrace, Battle Of Flowers, Tarantella.

Overture to "Porgy & Bess" (Gershwin); Majorie Mitchell piano and the Berlin RIAS Orchestra. Negro folk opera, regarded as Gershwin's best work.

"Rhapsody In Blue" (Gershwin); same pianiste and orchestra. Jazz concerto, orchestrated by Grofe.

The items are all well known and many may already have them in other albums. If not, to have them all together adds up to a recording which is well worth considering for your collection. An Ariola-Eurodisc original, the performances and the technical quality are well up to standard. (W.N.W.)

★ ★ ★

FESTIVAL OF HITS BY THE STRAUSS FAMILY. The Berlin Philharmonic Orchestra conducted by Herbert von Karajan. Stereo, D.G.G. 2538 300.

This is a most unusual record in one respect—no "Blue Danube"! In every other respect, it is very much the "mixture as before". However, it is a very pleasant mixture, with two waltzes, Tales from the Vienna Woods and Delirium Waltz—the Fledermaus and Gypsy Baron Overtures—the Pizzicato, Tritsch Tratsch and Thunder and Lightning Polkas—and the Egyptian and Radetsky Marches. Karajan is one of the few German conductors with the right approach to Viennese music, giving it the right touch of insouciant gaiety. If you like Strauss, then, you will find plenty to enjoy here. Reissues, of course, for this medium price disc, but good sound quality. (H.A.T.)

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.).

Melodies that will "last forever" . . .

CARNIVAL OF VENICE. The Black Dyke Mills Band. Stereo, Astor GGS-1444.

First formed in 1815, the Black Dyke Mills Band is known and esteemed around the World by brass enthusiasts, both for their total sound and for the quality of their featured instrumentalists. There are three solos in this program: Frank Berry, trombone, "Where E're You Walk"; John Clough, euphonium, "Carnival De Venice"; Jim Shepherd, cornet, "The Nightingale". The remaining tracks are: The Champions March—Hungarian Rhapsody No 2—Nabucodonsor Overture—Symphonic Poem, Les Preludes.

As you may gather from the above, the band leans towards orchestral rather than military band music and a sound that is smooth and round rather than obviously brassy. Therein lies much of their distinction and appeal.

Technically the quality of the disc is average—not brilliant but adequate for your enjoyment if you are partial to a group like the Black Dyke Mills Band. (W.N.W.)

★ ★ ★

FODEN MOTOR WORKS BAND. Conducted by Rex Mortimer. Astor stereo GGS 1450.

Anyone who likes to attend the occasional brass band concert in their local municipal park, will certainly find this album most enjoyable. It has a good mixture of old favourites with traditional arrangements. Recording quality is very good right throughout both sides. If you want to sample the disc, have a listen to "Swedish Rhapsody".

Track titles are: A Festival Prelude—La Chatalaine—Where E'er You Walk—Zauberflote (The Magic Flute)—Enchantress—Arabella—Rhythmic Skater—Pixie's Parade—Ida & Dot—Swedish Rhapsody. (L.D.S.)

★ ★ ★

SYNTHESIA. Mike Hankinson Plays the Classical Synthesiser. Interfusion (Festival) L-25169.

From a wide-ranging classical and "light" musical background in Britain, Mike Hankinson has been resident in South Africa for the past five years, being now classical organist with the South African Broadcasting Commission and with the S.A. Symphony Orchestra. He is also manager for Boosey and Hawkes of that company's section dealing with synthesisers and other electronic instruments.

For this recording, made in Johannesburg, he had access to four synthesisers and a 16-track recorder. With this background, he was certainly well placed to arrange and create the items on this album:

Sabre Dance (Khatchaturian)—Anitra's Dance (Grieg)—Dance of The Sugar Plum Fairy (Tchaikowsky)—Prestissimo (Vivaldi)—Adagio (Vivaldi—Toccata (Paradisi). On side 2 are items by J. S. Bach: Brandenburg Concerto; Allegro, Andante, Allegro Assai—Pastorale—Jig Fugue.

The performance is excellent and the sound predominantly clean. The sound is unmistakeably that of a synthesiser, but Hankinson has nevertheless sought to maintain the mood and impact of the original score. You may well question the relevance of so doing and, if you feel like that, the album is probably not for you. But, if you have no such inhibitions, it's good value at $3.99. (W.N.W.)

★ ★ ★

MILLION SELLER MOVIE THEMES (And Other Selections). The 101 Strings. Stereo, Alshire (Astor) S-5311.

In some of the numbers the 101 Strings do their traditional string-thing but in others they change the sound and dynamics to meet the needs of the music —but without ever compromising their committment to melodic sound. The tracks: The Entertainer—What'll I Do?—Tubular Bells—The Morning After—The Desperadoes – Clubman Special – By Rainbow Fountain—Morning On The Meadow—Swingin'Stampede—Theme For A Broken Heart.

The sound is clean and well balanced but I should perhaps mention that the 10 tracks only provide about 26 minutes of music, which can scarcely be regarded as generous. (W.N.W.)

MELODIES THAT WILL LAST FOREVER. Michael Collins and the Cathedral Strings. Stereo, World Record Club WRC s/4823.

This quite venerable Columbia recording has maintained its place in the World Record Club catalog for one main reason: it is devoted entirely to a gentle, relaxed presentation of melodies that have indeed proved themselves to have "everlasting" qualities. Here they are: Intermezzo (Cavalleria Rusticana)—Barcarolle (Tales of Hoffman)—Poeme (Fibich)—Ave Maria (Schubert)—Minuet (Boccherini)—Softly Awakes My Heart (Samson & Delilah)—Skaters' Waltz (Waldteufel)—Meditation (Thais, Massenet)—Le Cygne (Saint Saens)—Santa Lucia (Cottrau)—Largo (Handel)—Clair de Lune (Debussy).

In slow tempo, Michael Collins exploits every note of these well-known melodies, while the Cathedral Strings produce a lush sound, warmed by the double bass—a facet that might be missed if your loudspeakers are inadequate at the bottom end. Depending on your point of view, you might reject the album as schmaltz , or dreary, or "wall-paper" music. But for an album to remain current for as long as this one, a lot of people must think otherwise. And don't be put off by my reference to its venerable age; the sound is clean and the surface is quiet. (W.N.W.)

MAGIC BOW. Michael Rabin with The Hollywood Bowl Symphony Orchestra conducted by Felix Slatkin. Stereo, World Record Club WRC S/5129.

"My favourite record" remarked the person who handed me this album and, surrounded by hundreds of other WRC titles, this was quite a statement. Listen to it and the reason will be obvious enough. Michael Rabin combines a consummate technical skill with a beautifully rounded tone. Add classical excerpts that are as tuneful as they are familiar and you have a sound that will take the tension from any trying day:

Caprice Viennois (Kreisler)—Hora Staccato (Dinicu-Heifitz)—Meditation From Thais (Massenet)—Zigeunerwisen (Sarasate)—Moto Perpetuo (Paganini-Kreisler)—The Old Refrain (Kreisler)—Flight Of The Bumble Bee (Rimsky Korsakoff-Kreisler)—Introduction and Rondo Capproccio (Saint-Saens).

The orchestra is very subdued throughout but the violin tone, recorded close-up is clear and intimate. Some may find it too sugary but, to a lot of other people, it could easily become their "Favourite record". (W.N.W.)

For information on World Record Club albums, contact the Club at 605 Camberwell Rd, Hartwell, Vic 3124. Tel. 29 2636.

RUBYCON. Tangerine Dream. Stereo, Virgin L-35399.

If you like synthesised music, this is the album for you. Tangerine Dream is a trio of German musicians who specialise in the use of electronic instruments. On this album they use a mellotron, a double Moog synthesiser, a VCS 3 Synthi, a Synthi A, and an ARP 2600, not to mention various guitars and pianos. There are no definite tracks, the music is a blended whole, and flows smoothly from start to finish.

This is certainly not an album in the same style as many earlier records using synthesisers. No attempt is made to imitate conventional instruments; rather they are used as instruments in their own right. The result is pleasant listening, with a wide variety of tones and rhythms.

If you have an interest in modern forms of music, then this would be a good buy. The quality of the recording is excellent. (D.W.E.)

★ ★ ★

BOTH SIDES NOW. The Paul Robinson Players. W&G stereo 25/S/5609.

Easy listening music for dining or driving sums this disc up. Better sample a few tracks though, if you're finicky about sound quality. There is some edginess

LIGHTER SIDE

on the strings here and there and my pressing suffered from surface noise.

Ten tunes are rendered: Theme from "Elvira Madigan"—Blowin' In The Wind—Scarborough Fair—Windmills Of Your Mind—How Deep Is The Ocean—Ebb Tide—From Both Sides Now—Ship Of Dreams—Barefoot In The Park—September Song. (L.D.S.)

★ ★ ★

MR. ACKER BILK. Astor stereo GGS 1442.

Apparently, this album of Acker Bilk and his Paramount Jazz Band was recorded some time ago, as it has been electronically processed for stereo. This surprised me because my immediate impression on slapping the disc on the turntable was that the sound quality was good. Closer listening did suggest that the stereo image was vague—which is usually the case with this sort of record.

Fair dinkum stereo or not, it's a very lively record of "old-time" jazz with Acker Bilk's rather hoarse singing, in between blowing on the clarinet, being entirely in character with the music. Don't listen to it while dining though, otherwise you'll get indigestion from jiving about in your seat!

Ten foot-tapping tracks are featured: Jump In The Line—Delia Gone—Willie The Weeper—Blaze Away—Easter Parade—Marching Through Georgia—Carry Me Back—Lousian-i-ay—Under The Double Eagle—Franklin Street Blues. (L.D.S.)

★ ★ ★

LOST IN A DREAM. The Ink Spots. MCA stereo COPS 7250.

How about some songs crooned in the good old way? A bit corny perhaps but quite pleasant. Good for listening on a quiet Sunday afternoon. Record quality is okay.

Twelve songs are crooned: I'll Get By—Say Something Sweet—Do Something For Me—Castles In The Sand—My Greatest Mistake—Tell Me You Love Me—I'd Climb The Highest Mountain—Where Flamingoes Fly—A Fool Grows Wise—Lost In A Dream—I'm Lucky I Have You—You Can't See The Sun When You're Crying. (L.D.S.)

★ ★ ★

FOUR TOPS LIVE AND IN CONCERT. Probe stereo SPBA3081.

While I like those numbers which have been big for the Four Tops in the hit parades, I was not particularly keen on this album of a recorded concert performance. They start out sounding hoarse and the blistering pace set right at the outset does nothing to produce an air of mellowness. And why the record listener has to put up with frenzied shouts and shrieks of the audience I'll never know. Have a listen to it, before you buy.

Track titles are as follows: Are You Man Enough—Love Ain't Easy To Come Buy—Love Music (medley)—Reach Out I'll Be There—Standing In The Shadows Of Love—Midnight Flower—Baby I Need Your Lovin'—Keeper Of The Castle—I Am Your Man—Ain't No Woman (Like The One I've Got)—One Chain Don't Make No Prison—I Can't Help Myself. (L.D.S.)

★ ★ ★

BEGINNINGS. The Mitchell Trio featuring John Denver. Mercury stereo 633 8494.

Those not familiar with the Mitchell Trio and John Denver could be forgiven for opining that they sound exactly like Peter, Paul and Mary. And in fact at least some of the tracks were recorded as far back as 1965 when Folk was at its peak. A couple of the tracks have been electronically re-processed for stereo. As such, it is quite an enjoyable album and the sound quality is good throughout.

A list of the twelve tracks: "That's The Way It's Gonna Be—For Bobbi—Another Side Of This Life—Bells Of Rhymney—Never Coming Home—Get Together—Mr Tambourine Man—Like To Deal With The Ladies—Rabbit—She Loves You—Long Tall Texan—Violets of Dawn. (L.D.S.)

★ ★ ★

SLIM WHITMAN. Stereo, Festival L-35323.

Slim Whitman is in a romantic mood with eleven songs that dwell on amour: Happy Anniversary—She Thinks I Still Care—Hello Love—There Goes My Everything—Room Full Of Roses—Making Believe—It's All In The Game—If You Love Me—The Most Beautiful Girl—What I Had With You—Honeymoon Feelin'.

Backed with gentle C & W style rhythm, Hawaiian guitars and a chorus, it's all very smooth and tuneful. If you know Slim Whitman, I need only say he's in good form. If you don't know him, then this could be a pleasant introduction. The sound quality is excellent. (W.N.W.)

★ ★ ★

SOMETHING IN THE AIR. Simon Park. Stereo. EMI EMC-3059.

Simon Park has produced some rather original arrangements of a variety of popular songs. These include Funeral For A Friend—He's Misstra Know It All—I Am The Walrus—Cowboy—Something In The Air—The First Time Ever I Saw Your Face—Honky Tonk Women.

Whether his arrangements appeal or not must be a personal choice. For instance, I liked his version of "The First Time Ever I Saw Your Face", particularly at the start, which features a cor anglais solo. On the other hand, "Honky Tonk Women" seemed to me to be "over-arranged"—I prefer the original Rolling Stones' version.

If you think that this style might appeal to you, perhaps the best bet would be to have a quick listen before buying. The best track to pick would be one you are

familiar with. As the quality of the recording is excellent, you should have no worries on this point. (D.W.E.)

★ ★ ★

THE BOY FROM THE STARS. Jim Keays. EMI stereo EMA 308.

Another newcomer in the never-ending stream of pop-star possibles, Jim Keays is certainly a more-likely contender than many other candidates I have seen. Jim Keay shows more than usual talent as a writer of lyrics and his ideas and effects shown on this album are certainly original. The general theme is "science fiction moralistic"—someone from outer space comes to Earth and observes the mess we are in.

If you want to sample the disc, try the little track on side one.

There are nine tracks in all: The Boy From The Stars—Take It On Easy—Nothing Much Left—Space Brothers—Alchemical Takeover—Urantia—Kids' Blues—The Right Way To Go—Reason To Be Living. (L.D.S.)

★ ★ ★

THE GREATEST HITS OF ENRICO CARUSO, Vol. 2. Mono, RCA ARM1-0279.

Although referred to as Volume 2, this album was assembled at the same time as Volume 1, to commemorate the birth of Enrico Caruso in February 25, 1873.

Both are from very old recordings which exist only because Caruso believed in the future of the phonograph and dignified it with his patronage. The oldest recording in this collection dates back to 1904 and the most recent to 1920. In fact, they are surprisingly good and the voices come through strong and clear, despite the inevitable background noise. Obviously, great care has gone into their reclamation.

There are thirteen tracks in all, with titles too long to identify here but they are from (and I abbreviate); Pagliacci, Carmen, La Boheme, Tosca, Martha, with "Ave Maria" (Kahn). On side 2: La Traviata, Faust, L'Elisir d'Amore, Xerxes, Lucia di Lammemoor; "Mattinata" (Leoncavallo), "Over There" (Cohen).

Some old recordings serve only to disillusion one about cherished impressions. You won't feel this way about Caruso, a great tenor by any standards. (W.N.W.)

★ ★ ★

DUO LEON-REOS. Philips stereo 6348 107

Duo Leon Rios are a pair of agile-voiced Latin-Americans backed by harp, guitars and other stringed instruments. Their slightly plaintive style of singing is well complemented by the instrumental backing and adds up to a very pleasant album.

The recording was generally very good although some tracks on my sample pressing were not without their share of "prickles".

Track titles are: Elegia Sin Nombre—La Marca—LLuvia En El Campo—A La Ronda, Ronda—Le Puse La Firma—En El Fondo Del Rio—Panal Al Viento—La Nina Maria—La Noche Del Gato—Tonado De La Noche—Espigas Para Un Recuerdo—Olmue Mi Amor. (L.D.S.)

★ ★ ★

MAX BYGRAVES. Stereo (?) Astor GGS-1446

Without explaining why it should be necessary in this day and age, Astor describe this album as "electronically created stereo"; nor do they refer to some apparent over-recording, allowing Max Bygraves to add a second part in

Allen Organ: "good value"

STEPHEN HICKS AT THE ALLEN COMPUTER ORGAN. RCA · Victrola VVM1-7025.

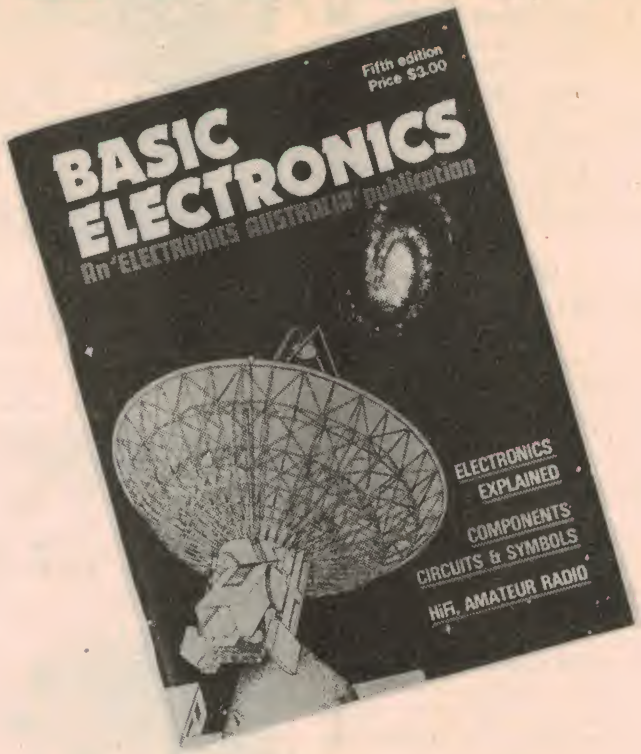
A few years ago there was argument and speculation as to whether electronic organs could ever fill the role of the traditional classical pipe instrument. With the emergence of classically designed Rogers electronics (our review page 94, April issue) and this new Allen computer organ, the electronics are indeed filling just such a role. Now we are in a whole new ball game: pick the difference – and this may well be a major source of interest in this new album.

Installed in St Augustine's Church, Kilburn, England, the organ here has the benefit of appropriate building acoustics and it certainly sounds the part, at the hands of 26-year-old organist Stephen Hicks. But, having said that, I can imagine organ enthusiasts listening critically to the fine detail to pick the "electronic" characteristics. For example, the bass is loud but scarcely profound; the sound is complex but so acoustically "tidy" as to suggest "ideal" rather than typical ranks; and the dynamic gradation and range might also be considered unnaturally well controlled. Is this tantamount to saying that we wouldn't welcome an "ideal" pipe organ either?

The actual program includes numbers commonly requested in organ meet recitals: Toccata (Widor) – Trumpet Voluntary (Hicks)– Chorale Prelude "Wachet Auf" (Bach) – Toccata and Fugue In D Minor (Bach) – Ride Of The Valkyries (Wagner) – Suite Gothique (Boellman) – Transports De Joie From "L'Ascension".

If this was a $6 plus album, one might debate its merits and demerits at greater length but, at the Victrola price of under $3, it would represent good value for an organ enthusiast, even as a conversation (or argument) piece! (W.N.W.)

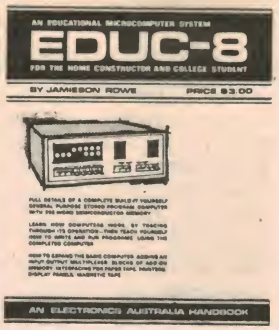
NEW . . .



Almost certainly the most widely used manual on basic electronics in Australia. Begins with the electron, introduces and explains components and circuit concepts, details the construction of simple receivers. Separate chapters on test instruments, servicing, amateur radio, audio techniques, stereo sound reproduction. The basic text is similar to the fourth edition but chapter 18, completely rewritten, now contains six practical projects for home construction. "Basic Electronics" is widely used in radio clubs, in secondary schools and colleges, and in W.I.A. Youth groups.

Price: $3.00 plus 60c pack and post.

ON THE PRESS . . .



To meet a special demand from tertiary education centres and individual enthusiasts, we are currently preparing a handbook which will contain the complete series of articles on the EDUC-8 build-it-yourself computer (August 1974 to August 1975). It will be a self-contained manual for those who have constructed the EDUC-8; a valuable reference for others who want to study computer theory and practice.
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Fundamentals of Solid State . . . provides a wealth of information on the structure, operation and application of semiconductor devices. For amateur, hobbyist, student, technician and engineer.

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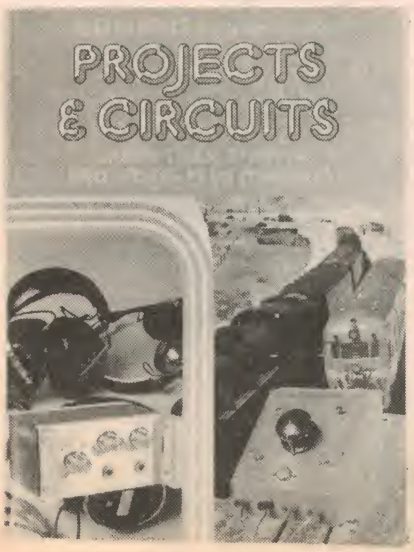
REPRINTED . . .



PROJECTS & CIRCUITS

Heavy demand exhausted our initial stock but a reprint is now available. "Projects and Circuits" contains full constructional details of more than thirty assorted practical projects, all but one of them reflecting current technology. The exception? An old-style electrically pulsed grandfather clock that could be an interest centre in any home! An ideal companion volume for "Basic Electronics"

Price: $2.00 plus 60c pack and post.

(Also available direct from some newsagents)

LAST CHANCE

We have a few copies only left of our 1974 "HiFi Stereo Annual". It is NOT a random collection of articles but a systematic study of sound reproduction beginning with the mechanism of the ear and the efforts of men like Edison—right through to modern 4-channel sound. Tells you how to select a hifi system to suit your particular needs. While they last . . .

Price: $2.00 incl. pack and post.

COUPON OPPOSITE

the first track.

But, quibbles aside, Max Bygraves turns on the kind of tuneful, personable performance that has made him so popular on the club circuit, on stage and television. The tracks:

Jealous Heart—My Cup Runneth Over—Harmonising—Rolling Round The World—Bachelor Boy—Games That Lovers Play—I'm Always Chasing Rainbows—Always Together—Once A Star Of Music Hall—Daydream.

Apart from the limited stereo effect, the sound lacks brightness, but it is clean enough. In other words, the recording is okay if you want Max Bygraves but don't expect big, wide sound. (W.N.W.)

★ ★ ★

MIND STROLL. Greg Sneddon. Stereo. Mushroom L-35,356.

Recorded late last year at Trafalgar Studios, Sydney, and written and composed by Greg Sneddon, this is an all-Australian production. Featured titles are: Mind Stroll—Winter—Take It Slow And Easy—A Spell Of Destruction—Minuet In E—Concerto For Two Handed Plectrum—Madman.

The quality of the recording and the stereo separation are both very good. The track I particularly liked was "Winter", which has an interesting introduction. Other tracks of interest are "Mind Stroll" and "Madman". This record would be a good choice if you like to do more than just listen, as there are a lot of thought-provoking lyrics, as the title would suggest.

On the whole, my reaction to this record was favourable, although it may be frowned upon in the southern-most "island" state, as it has been left off the "Australian Recording" insignia! (D.W.E.)

★ ★ ★

THE VERY BEST OF MATT MONRO. Various orchestras. Stereo, EMI Columbia SCXO-6562.

As this album played on and on, I picked up the jacket just to make sure that it wasn't somebody's "Golden Hour Of ..." But it is a generous program comprising 20 songs recorded in the period 1960 to 1973, and each identified, along with the accompanying orchestra. Monro fans may want to make something out of the details but, having no such involvement in detail, I was content merely to listen to a pleasant performance of familiar songs:

To quote just a few of the titles: Born Free—From Russia With Love—Walk Away—Michelle—On A Clear Day—Somewhere—Impossible Dream—Portrait Of My Love—My Kind Of Girl—Yesterday—This Time.

Despite the variety of sources, the disc plays through smoothly and pleasantly. Good value if you like the songs in general and Matt Monro in particular. (W.N.W.)

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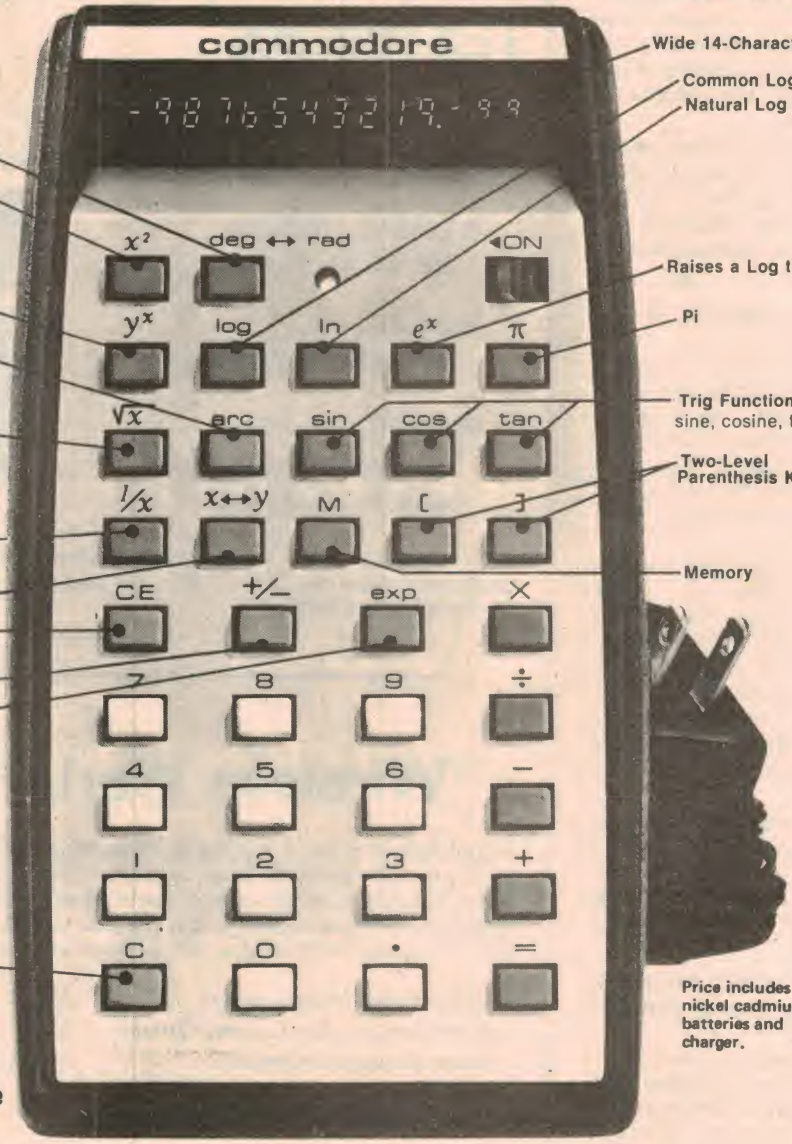

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Books & Literature

Radio servicing

ELEMENTS OF RADIO SERVICING, third edition, by William Marcus and Alex Levy. Published by McGraw-Hill Book Co, New York, 1967. Hard covers, 240 x 195mm, 426pp, many circuits and diagrams. Price in Australia $9.65.

This is the third edition of this almost classic text on radio and electronics servicing by Marcus and Levy, and presumably the edition currently available—despite its 1967 publication date. And at the price quoted it is no doubt excellent value for money; most texts of this size and overall quality tend to cost around double the price.

However I suspect at least part of the reason for the attractive price is that this edition is now getting rather dated, and may have been hard to shift at a higher price. Fundamentally, the book is still back in the valve era, spending considerable time on such circuit details as full-wave valve rectifiers and pentagrid converters. There are two chapters on transistor sets, one dealing with car radios, but not surprisingly these deal with the types of device and circuitry common in the 1960's.

This is not to say that the book doesn't have any useful information. There are some quite good sections on alignment and general servicing techniques, which would be just as applicable to today's sets.

All the same, I hope Marcus and Levy come out with a fourth edition, to bring their work fully up to date. Not specifically for radio servicing, because even now it is almost cheaper to throw radio sets away; more for electronics servicing in general, which we are likely to need for some time to come.

In the meantime, the third edition may be worth getting to deal with the "antiques".

The review copy came from Dick Smith Electronics Pty Ltd, 160-162 Pacific Hwy, Gore Hill NSW 2065 (J.R.)

Second copy WRH

WORLD RADIO-TV HANDBOOK 1975, edited by Jans Frost. Published by World Radio and Television Handbook Co. Ltd, Denmark. Soft covers, 152 x 228mm, 440pp, some illustrations. Price in Australia $8.95.

A second review copy of this volume has been received, from Technical Book and Magazine Co Pty Ltd, of 289-299 Swanston Street, Melbourne, who advise that the book is now in stock. For detailed comments readers are referred to the review given in the May issue, by our shortwave correspondent Arthur Cushen. In summary, however, Arthur described it as the "best edition yet", and an invaluable reference for all shortwave listeners.

Audio text updated

THE AUDIO HANDBOOK, by Gordon J. King. Published by Newnes-Butterworths, London. Hard covers, 250 x 160mm, 286 pp, numerous photographs and diagrams. Price in Australia $13.00.

Some time back, the publishers advised me that Gordon King was planning a new edition of his popular book "The Hi-Fi and Tape Recorder Handbook"; they invited comment on how best the book could be revised to meet the needs of Australian readers. In summary, I suggested that Australian hifi enthusiasts were interested in quality equipment, stereo more than mono, solid-state more than valves, Japanese and American equipment, more than British and Continental.

Like the fabled "Paddy's gun", with a new lock, stock and barrel, Gordon King's up-dated volume has a new name, new approach and completely re-written text! The mono heritage, valves and photos of once-famous English products are gone, to be replaced by text and diagrams intended to communicate principles—unlikely to date with particular makes and models. I was tempted to use the term "textbook approach" except that it might sound forbidding. It is a textbook, but one that any enthusiast could read and understand.

The chapter headings are: Fundamentals—Requirements for Hi-Fi—Preamp. and Control Circuits—Power Amplifiers and Supplies—Adjustments, Measurements—Loudspeakers & Headphones—Disk Recording—Disc Reproduction—Microphones & Mixers—Tape Recording—FM Radio—Surround Sound & Four-Channel—Index.

It will be apparent from the above that tape recording has not only disappeared from the title; it is confined to a single chapter, but this is not inappropriate in a book which seeks to cover from audio fundamentals to surround sound. In summary: a useful and well written text. Copies should be available through booksellers or from the Australian office: Butterworths, 586 Pacific Highway, Chatswood 2067. (W.N.W.)

Product reviews & releases

Decca 26-inch hybrid colour receiver

The Decca "33 Series" 26-inch colour television receiver, currently being marketed in Australia by the Trident organisation, is a good example of an established English model, redesigned for Australian conditions. It uses transistors and ICs for most circuit functions but valves in the audio and deflection stages.

It so happened that the start of colour television in Australia coincided with the development of solid-state receivers so that, by and large, Australian viewers were spared the rather cumbersome all-valve designs, and their inevitable early obsolescence.

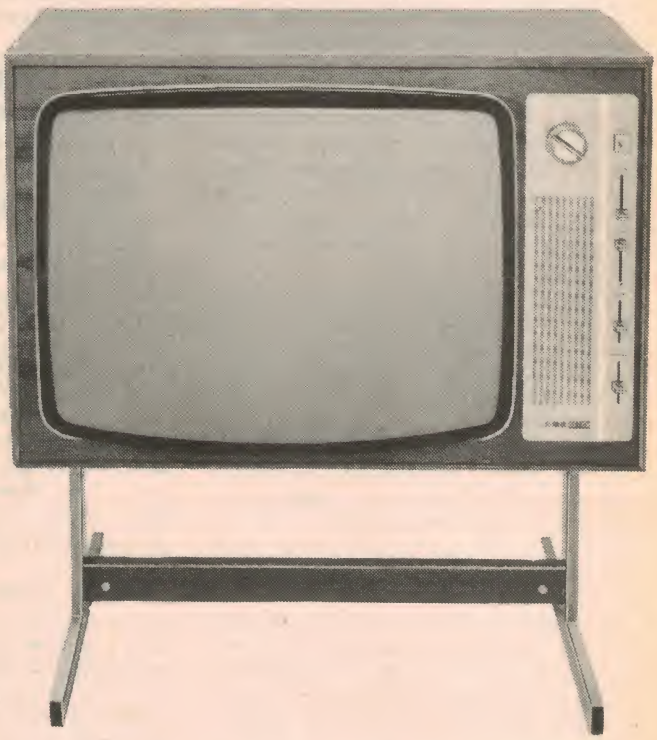
However, projection into the fully solid-state era has not been without its problems, either. The technology was sufficiently new, particularly in this country, for some problems not to have been foreseen before the receivers came on to the market. In consequence, some of the technically up-to-the-minute designs have had their share of "teething" troubles.

We were interested, therefore, to take a look at this imported Decca hybrid model, which comes to Australia after having been tried and proven on the British market. Identified on the circuit as "33 Series (25kV Australian)" the receivers being brought in by Trident conform in all respects to Australian standards.

Looking at the circuit, a 13-channel solid-state tuner feeds into the IF channel, then into an integrated circuit synchronous detector and AGC generator. This is followed by a transistor video amplifier and another IC as sound IF and demodulator. A conventional triode-pentode valve feeds the loudspeaker.

The entire PAL chrominance circuitry is solid-state (IC and discrete transistors) but the deflection system—sync separator, oscillator, outputs and EHT—uses familiar valve technology, rounded off by a mains transformer type power supply. The "back end" of the receiver would therefore look familiar to a serviceman accustomed to valve and hybrid monochrome technology.

Another point about the receiver is that it uses a 90-degree tube, which means that it is somewhat deeper front-to-back than 26-inch receivers using the more recent 110-degree type. However, this is only likely to be a consideration in small rooms and is of no consequence at all if the receiver stands across a corner, which it will do very neatly because of its other compact dimensions. The width of the cabinet is 750mm, the height on stand 840mm, depth of the cabinet 340mm and overall depth 540mm.



Because of their special construction, modern colour picture tubes do not require a separate panel of safety glass. In the Decca 26in receiver, there is virtually no escutcheon, the tube protruding through the cabinet front.

As a compensating factor, 90-degree tubes as a class offer very good picture geometry. In this particular receiver, the test pattern appeared to be completely symmetrical, free of "pin-cushion" effect and with a truly round reference circle. Potential picture brightness was higher than one could comfortably use in the viewing room, at night or in ordinary subdued daylight.

The cabinet, by the way, is a simulated walnut finish, neat but completely plain, with a moulded composition cover enclosing the back. The slide controls and speaker fret are all grouped on a single brushed metal panel on the right-hand side.

To gain access for service, the back cover is removed, after which the vertical chassis can be swung out and down, giving access to the wiring and to the various PC boards. Push-on connections allow these to be removed and replaced if necessary.

At the suggestion of Berry Beresford (formerly of Mullard, now the National Technical Manager of Trident) we simply nominated a private address, allowing his organisation to proceed without any hint that more was involved than a normal sale and installation in a suburban home.

All we can observe is that this part of operation was routine. The installer put the set in position, connected it to an existing outside aerial, "de-gaussed" and checked it and pronounced it okay—with one reservation: he wasn't too happy about it being alongside a hifi speaker, with a magnet that might possibly affect convergence if the two were moved any closer than they were at the time.

In fact, we could pick no obvious interaction and it was difficult to fault the receiver at all, without resorting to the "nit picking" level.

On a blank raster, there was a slight greenish tinge to the top left and a slight reddish tinge below and left of centre but neither could be seen at normal viewing distance on monochrome pictures, and there was no obvious sign of anomalous tint on colour programs. In summary, having looked at a lot of good colour in various countries, I can only say that I have seen pictures as good but certainly not better than on this particular receiver.

The sound was clean and free from frame buzz and all slide controls worked smoothly with normal viewing settings in

FM stereo & cassette player for cars

Readers on the lookout for an entertainment unit for their car might well consider the Medallion 65-490, recently submitted to us by Sideband Electronics. A combined cassette stereo tape player, AM radio, and FM stereo radio, it will provide entertainment of one kind or another regardless of where a traveller should find himself.

Considering the facilities which it provides, the Medallion 65-490 is remarkably compact. Excluding the dial, it measures 187 x 160 x 65mm. It is designed to fit directly behind the dashboard of the car, using the fairly standard dial cut-out and control holes found in many cars. To make the unit as universal as possible the two control shafts are mounted in slotted holes and equipped with an ingenious system of retaining washers which gives a choice of four fixed positions for each shaft.

The unit is supplied with a dress plate finished in chrome and imitation wood grain. The knobs are finished in chrome and black leatherette and are large enough to mask any elongation of the holes which might be necessary in the dress plate.

Electrically, the set would seem to follow fairly standard practice. There are virtually two tuners, an AM tuner using a 455kHz IF and an FM tuner using a 10.7MHz IF. These feed a common stereo amplifier, according to which one is selected. The audio amplifier is rated at 4W per channel into 4 ohms. Speakers may be either 4 or 8 ohms.

The two main control shafts are concentric types, providing tuning (common to AM and FM), balance, tone, volume and on/off switch. (Push-pull action on the volume shaft.) There is a locking press button to select either AM or FM and two larger spring loaded buttons on the cassette mechanism. One provides fast forward wind and the other is the eject button.

The compact format is undoubtedly due in part to the novel cassette mechanism. The cassette is inserted end on, which means that the opening to take it is quite narrow and is conveniently located immediately below the dial.

Cassette operation is particularly convenient. The cassette is simply pushed in, at a slight upwards angle, with a minimum of effort. It locks in quite positively and this is all that is required to play a cassette. The loading action overrides the normal on/off switch, should it be off,

or either of the radio circuits should they be in use. Ejecting the cassette reverses the process.

Inserting the cassette brings up a green indicator light which remains on until the end of the tape run, when it is extinguished. In fact, it is in parallel with the motor and indicates that the motor has been turned off when the tape finishes.

Unfortunately, in the unit submitted to us, this function was not entirely reliable. Sometimes it would switch off, sometimes it would not. When it failed, the motor churned merrily on, presumably chewing up the drive belt, or whatever the mechanism is. This would be a point to watch if you are buying a unit.

The set comes complete with a large package of hardware. There is a rear support strap, a generous assortment of nuts, screws and washers, a suppressor capacitor for the generator or alternator, and a suppressor resistor for the HT cable.

Bench tested in our own workshop, using a very modest indoor aerial, the set performed extremely well. It gave good stereo reception of the local FM station, and was completely noise free. This was gratifying in a location which is notoriously noisy, and considering the modest power of the local FM transmitter at the present time.

Although there is no mention of it in the accompanying literature, we gained the impression that the FM tuner uses some form of AFC control; a worthwhile feature where a unit is to be used in a car.

Reception of AM signals was less impressive, but this was due almost entirely to the heavy electrical noise in the area. In more typical locations it should perform well.

Reproduction could not be called high fidelity by the best lounge room standards, but was pleasant and well balanced. It should be perfectly adequate in the environment for which it is intended.

Apart from the intermittent automatic stop already mentioned, the only other adverse comment is that the tuning control is rather rough. Even so it is quite positive and does not seriously hamper the tuning.

Price of the Medallion 65-490 is $100 (including tax) for single units, or 20% less for batches of six or more. Further details from Sideband Electronics Sales and Engineering, P.O. Box 23, Springwood, NSW, 2777. (P.G.W.)

Decca colour receiver

all cases being at about half-travel. The station selector mechanism did feel slightly springy due, I gather, to the use of a nylon rather than a metal spindle.

Checking back on the installation routine, I discovered that Trident's standard procedure is to give every new receiver an 8-hour "soak" run to expose any faults. It then undergoes a complete check and setting-up procedure—degauss, purity, convergence, colour balance, etc. The back is screwed on and the set is expected to operate without further ado in any ordinary home situation.

According to Berry Beresford, careful pre-adjustment of receivers (not just the Decca) obviates most of the much-talked-of installation problems. In fact, Trident installers do not get involved with the receiver at all. Their job is to do the actual installation, draw attention to any aerial problems and make sure the customer understands the controls. In the rare event of problems in the receiver itself, a specialist technician takes over.

Trident's price for the 26-inch Decca, as illustrated, is $799 plus $15 for the stand. This includes tax and installation, the provision of an indoor antenna where required (an outdoor antenna is recommended) and/or a balun to convert from 300-ohm cable to the receiver's own 75-ohm coaxial input. The receiver is covered by a 90-day warranty, for all parts and labour, with 12 months' warranty on the picture tube.

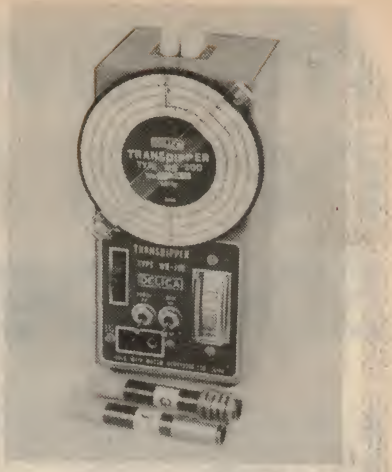
Purchasers of this and other receivers from Trident are eligible to join Trident's "Buyer's Club" service facility. The basic membership fee is $25 per year and the first and second service calls in any one subscription year cost the club member $15 per call; this is an all-up figure covering labour, parts and workshop service as necessary. The next three calls in any one year cost $22.50 each, any further calls being free. Thus club members pay a minimum of $25 per year but, even in the most traumatic situation, the total additional cost in that year cannot exceed $100.

Rental charge for the Decca 26-inch receiver is $28.50 per month. This includes the stand, indoor aerial and balun, installation and service. (W.N.W.)

NEW PRODUCTS

High quality dip oscillator

A good dip oscillator is a very valuable piece of test equipment particularly on the communication scene, whether amateur or commercial. One such instrument currently being stocked by Dick Smith Pty Ltd should appeal to both the advanced amateur and the professional communications engineer.



It is the Delica Transdipper WB-200, made by Mita Musen Kenkyusho Ltd of Japan. It covers from 0.4MHz to 200MHz, by means of seven plug-in coils. Two coil sockets are used, and the other for the remaining four coils, covering from 0.4 to 65MHz.

In fact, the unit employs a dual two gang tuning capacitor (AM/FM type) and two completely separate Colpitts oscillator circuits, thereby achieving more acceptable L/C ratios overall.

The basic unit measures 75mm (W) x 155mm (H) x 70mm (D). To the height should be added 86mm for the coil and coil socket assembly. All the coils are on 10mm diameter formers and, except for the lowest frequency one, are single layer windings. As a result they are easily introduced into confined spaces. The windings are protected by a tough plastic covering.

The unit sits easily in the hand and the tuning dial extends over the edge of the case and can be operated by the thumb. The dial itself is fitted with clear etched scale. The meter proper is an edge type and its sensitivity is controlled by an edge type knob.

Other features include an internal audio oscillator which can be switched in to modulate the RF signal, facility to plug in an earphone to convert the unit to a wavemeter, and provision to plug in an external power supply.

In use we were impressed by a high order of accuracy and the freedom from spurious dips. On the VHF bands particularly, where many dip meters fall down, the indicator meter showed only a steady variation from one end of the scale to the other.

One criticism is that the accompanying literature is in Japanese and there seems little chance that English versions will be available. This is a pity because, while the instruction manual is probably quite elementary, a second booklet is obviously a detailed discussion on the various ways in which a dip meter may be used, and this could be quite valuable.

Another criticism concerns the rather involved procedure needed to replace the batteries. It is necessary to remove no less than 14 small machine screws to open the case, plus another two to release the battery container.

But these are relatively minor points which should not really deter anyone with a need for an instrument of this type and quality.

Price of the WB-200 is $142.00. While not cheap, this instrument is obviously designed for the advanced amateur or the professional communications engineer who needs an instrument which is sturdy, reliable, accurate, and substantially free from false indications. (P.G.W.)

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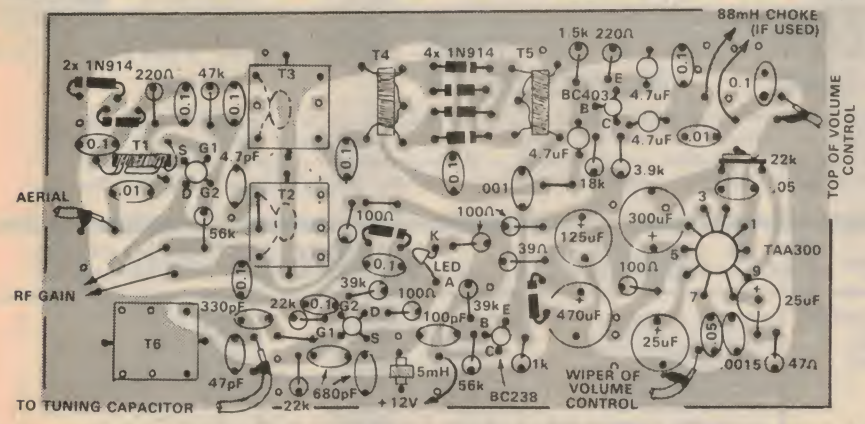
DIRECT CONVERSION RECEIVER

Following the description of a direct conversion amateur receiver in last month's issue, we have been able to obtain some additional information from the author which should assist those contemplating construction.

First, the printed board. This was mentioned in last month's article, but was not included in the "Break-In" text, it being assumed that these would be available to New Zealand readers via NZART. We had hoped to receive a copy of it in time to accompany the June article, but fate decreed otherwise. The board pattern is reproduced herewith, actual size, together with a reverse board image showing the location of components.



Ferrite for the mixer transformers: Although not unduly critical, it must be suitable for HF operation and something like the Neosid F14 would be recommended.

Additional coil details: T2, T3, and T6 are wound on Neosid 3/16in formers with F14 slugs and mounted in aluminium cans. As can be appreciated from the above, and the board layout, there is no magnetic coupling between T2 and T3. The only coupling is via the 4.7uF capacitor and the arrangement is designed to function as a top coupled band-pass filter 0.5MHz wide and having an impedance of 10k. The link coil coupling to T3 consists of 6 turns.

(Editorial note: The wiring pattern shows a second 100 ohm resistor in the drain circuit of the oscillator FET, not shown in the circuit. We assume it is probably a parasitic suppressor.)

IREE Convention in August

Over 1500 Delegates are expected to register for the "International Electronics Convention '75" being conducted by the Institution of Radio and Electronics Engineers at the University of New South Wales from August 25th to 29th inclusive.

A most comprehensive display of electronic equipment and developments covering some 30,000 square feet of space will be open to the trade and some 20,000 visitors are expected.

The Keynote address at the Convention will be delivered by Mr. David R. Israel, Chairman of AEROSAT Council of the Federal Aviation Administration, Washington DC.

More than 250 technical papers, contributed by many of Australia's most notable engineers and from top ranking scientists and engineers in the United Kingdom, Europe, Asia and the Americas will be presented. The papers specially selected for their importance, covering a wide range of electronic subjects, will be delivered to large numbers of delegates each day using six lecture theatres.

Mr. Keith Finney, General Secretary and Chief Executive Officer of the Institution of Radio and Electronics Engineers said that all the major Australian manufacturers and suppliers of electronics and communication equipment are participating in the display. Also included in the display is a large contingent of British companies who will occupy seven stands, and will be one of a number of overseas countries displaying in the largest Convention ever to be held.

The Amateur Bands

by Pierce Healy, VK2APQ

OSCAR 8—International conference

A program for future amateur satelitte service activity, together with proposals for the development of suitable spacecraft was discussed at an international conference in March 1975.

This conference was held in the Goddard Space Flight Centre, Greenbelt, Maryland, USA, from 21st to 24th March, 1975. It was convened to define the next OSCAR satellites and to decide the responsibilities of the national groups involved.

Australia was represented by David Hull, VK3ZDH, chairman, WIA Project Australis group. David's report contains some interesting information.

Others present were Larry Kayser, VE3QB, and Bob Pepper, VE3AO, from AMSAT Canada; Karl Meinzer, DJ4ZC, from AMSAT Deutschland; Chuck Swedblom, WA6EXV, and Dick Kolbly, K6HIJ, from the San Bernardino Microwave Society; Jan King, W3GEY, and Perry Klein, K3JTE, from AMSAT headquarters.

The main discussion concerned OSCAR 8 and the possible launch vehicle/orbit opportunities for it. There were several alternative possibilities, including a joint Australian/Canadian (VK/VE) satellite in an OSCAR 6/7 orbit, but the conference decided to go ahead on development of an AMSAT phase III advanced spacecraft for launch in mid-1978 and to concentrate all effort to that end.

Development is constrained by the launch date of the last Itos launch on Delta 2910, a call-up mission with a mid-1978 target. Failing this launch the Titan 3C/377 military launch could be considered, as could the space shuttle scheduled for June 1979. The orbits of these launches are; 900 mile, sun synchronous (as per OSCAR'S 6 & 7) for the Delta, geostationary for the Titan, and low altitude low inclination for the shuttle. None of these orbits was considered entirely satisfactory for the amateur satellite service at our present state of development.

The optimum location for the geostationary satellite was impossible to find; it would serve only one area for long periods of time. The 900 mile orbit had been fully explored with OSCAR's 6 & 7 and there seems little point to a lower shuttle height orbit. The only alternative seems to be an initial 900 mile orbit with a subsequent in-flight manoeuvre to raise the apogee from which height considerable radio range would result for much of the orbit.

The conference had in mind to provide a viable alternative to the 20 metre band without the propagation problems of the HF bands. This in-flight manoeuvre would require the spacecraft to be fitted with an apogee kick motor (AKM; a small internal rocket motor) and this would be a completely new development for the OSCAR series. This would be fired by ground control some orbits after launch at a time determined by orbit mechanics.

To this end, and to advance the command techniques, it was decided to fly, for the first time, an inboard computer. This would integrate the command, telemetry and general housekeeping of the whole spacecraft. The computer would interface directly with ground station equipment (GSE) computers in the worldwide chain of command stations. The spacecraft computer would also arrange telemetry trtansmission in any format (RTTY, CW, BCD or others) as decided by software fed from the command stations. Commands and operating schedules would also be decided by ground loaded software.

The principal transponder would be a linear unit of 150kHz bandwidth with reception either in the 2metre or 70cm band and transmission in the alternative (70cm or 2metre band). The exact choice of the uplink, and thus the downlink, will be referred to a poll of interested parties.

In general, VE, VK, and some W's favoured 2metres up and 70cm down; DJ and AMSAT HQ favoured the alternative (as in OSCAR 7).

Two or three beacons will be flown. There will be a beacon at each end of the passband and possibly, a 2304MHz beacon if the present problem with the USA FCC on this question can be overcome.

The AKM should push the satellite into an initial apogee over the North pole of 7.2 earth radii. This would provide Australia with two to three hours' access to the whole of North America and Japan every 12 hours. In time the apogee would drift southwards, increasing the time to a maximum of perhaps 10 out of 12 hours' orbit time. About 1000 watts EIRP would be required for effective communication at apogee.

Group responsibilities in building OSCAR 8 are as follows:-

AMSAT Deutschland: Design major units, i.e., transponder, integrated housekeeping unit and computer.

AMSAT Canada: Build spacecraft, both prototype and flight units.

Project Australis: Design and build GSE with computer, etc., provide prototype for test use and 5 or 6 units for world command stations before launch. Provide software for both spacecraft and ground computers.

San Bernardino Microwave Society: Design and build the 2340MHz beacon.

AMSAT Headquarters: Provide overall management, procure components, arrange launch, provide operational management once spacecraft is in orbit.

This is an ambitious program, subject to changes and modifications as circumstances may demand. The plan is, however, a logical expansion of the AMSAT-OSCAR program and, given reasonable fortune and support, is within the capabilities of the participating bodies.

In his report, David expressed appreciation of the WIA support for the Project Australis and OSCAR programs. Also to those attending the conference for their welcome and hospitality.

All amateurs and those interested in amateur radio are eligible to join AMSAT. Application forms and membership details may be obtained from:

Radio Amateur Satellite Corporation,
PO Box 27, Washington, D.C. 20044 U.S.A.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

LOCAL AND OVERSEAS NEWS

INTERNATIONAL AMATEUR RADIO UNION: The first constitution of the IARU was adopted by 23 national radio societies meeting in Paris on 17th April, 1925. The progress over the past 50 years is probably best illustrated by the fact that the countries represented by its 88 member societies contain some 700,000 amateur stations.

Recently the constitution was revised to recognise the IARU regional organisations—Region I: Europe, Africa and part of Asia; Region II: North and South America; Region III: Japan, South East Asia, India, Australia, New Zealand and Oceania.

Also adopted was a proposal from the Radio Society of Great Britain that the affirmative votes of two-thirds of member societies will be required in order for it to succeed.

The need for an international organisation to co-ordinate and foster international two-way communication is as great as ever. With the approach of the ITU World Administrative Radio Conference 1979 amateurs will be made increasingly aware of the necessity to support the IARU through their national societies.

IARU Region II will hold its next conference in Miami early in 1976. A major topic on the agenda will be the preparations being made on behalf of amateur radio for the 1979 International Telecommunication Union World Administrative Radio Conference.

SPACE SCIENCE INVOLVEMENT

This is the title of an ARRL curriculum supplement for classroom use. It is intended as a guide for classes wishing to make active use of a satellite to study space science, physics, mathematics, astronomy and communications. The contents were developed by educators at the Talcott Mountain Science Centre, USA. A copy was received from David Hull following his return from the AMSAT conference.

The introduction deals with the broad scene—a look back—origins of OSCAR—Oscars past, present, and future. The first section proper deals with points such as: What keeps a satellite up? What governs the speed of a satellite? OSCAR orbital studies and Doppler measurements.

The second section deals with satellite tracking and orbital mechanics, finding OSCAR and determining the orbital period, scientific and mathematical activities involving OSCAR, and scientific and mathematical activities using telemetry.

Questions and answers are provided as a guide to teachers and a measure of students' progress.

The appendices contain: Useful constants, formulae and conversions; equipment recommended for classroom use of OSCAR 6; transmitting through OSCAR 6; satellite systems; pre-post tests for elementary and second grades; instructor's evaluation of curriculum guide.

The publication is considered an excellent guide for educationists, particularly science masters. A revised edition should be available in Australia shortly. Availability will be advised in these notes.

NOVICE LICENSING

The official announcement, late April 1975, of the introduction of novice licensing and the date of the first examination, did not coincide with the deadline for these notes.

Therefore it was not possible to feature some of the information that came to hand prior to the examination date, the 24th June. However, from the interest shown, it appears that the number of applicants would have been fairly large.

This major amendment brings Australia into line with a number of overseas countries where such a grade has been available for many years, notably in the USA.

It is interesting to note that this subject has been prominent in the columns of "Electronics Australia" since 1968. Also that in some respects the requirements set out for the novice licence are much more liberal than the recommendations made by a WIA special committee set up to investigate all aspects of the novice type licence.

VK ELECTORATES AND ZL COUNTIES: Activity is usually high around 3680kHz each night from about 0730GMT among those looking for contacts towards the "ACE" Award for Australian electorates or the

AMATEUR BANDS

"NZ 112 Award" for New Zealand counties.

If you want to know more about the awards join in the activity when there are a number of ZL mobiles on the band.

SEANET CONVENTION: Planning a holiday? Keep in mind the convention to be held in Kuala Lumpur on the 7th-9th November, 1975. The Malaysian Amateur Radio Society is sponsoring the event in 1975 and hopes to have 9M2SEA as the convention station call sign.

At the 1974 SEANET convention held in Manila over 100 were in attendance. The South East Asia net meets every day at 1200GMT on 1432kHz. Stations throughout Asia, the Middle East, East Africa, the Pacific and Indian Ocean, check-in regularly.

MORSE CODE TAPE SERVICE: The NSW division of the WIA has a series of Morse code practice tapes, either cassettes or open reel, available to anyone wishing to learn or improve their speed.

Write to—WIA Tape Service, K. W. Black, PO Box 43, Erskineville NSW 2043 for full details.

A number of lecture tapes are also available. These cover many aspects of amateur radio theory and short-wave listening. Some are illustrated by colour slides, and are ideal for clubs or group education.

RADIO CLUB NEWS

EASTERN & MOUNTAIN DISTRICT RADIO CLUB: The need to publicise amateur radio was effectively pointed out by the Mayor of Nunawading, Councillor Peter James, at the inaugural meeting of the Nunawading Branch of the EMDRC.

In his address, Councillor James made the point that amateurs were themselves responsible for lack of publicity. If help and support was wanted from local and other government departments, amateurs must be active in the community. He also advised that the Nunawading council were considering providing facilities for the club. This would include a transmitting room for exclusive use by the club, as well as general meeting rooms which would be shared with other organisations as part of a community complex.

Westlakes Radio Club is one of the most progressive clubs in Australia, particularly in regard to its youth training activities. The photograph shows the club premises in York St, Teralba, NSW. Note the 60 ft. tower at the rear of the building.

Nearly eighty amateurs, short-wave listeners and friends attended this meeting, held in the Coffee Shop at the Nunawading Civic Centre on Friday night 16th May, 1975. The Acting Superintendent, Radio Branch Richmond, Mr Bob Deany was guest speaker who spoke on "Interference and the amateur". At the conclusion of the address Mr Deany presented Geoff Atkinson, VK3YFA, EMDRC president, with the Nunawading Branch station licence and call sign VK3BNW. Two officers of Mr Deany's staff were also present at the meeting.

In a letter to these notes Mike Thorne, VK3ZVN, chairman of the Nunawading Branch, said: "We are indeed fortunate in having the support of councillors and senior municipal officers. We are accepting the challenge given us by Councillor James. Through the Nunawading branch we shall be looking for opportunities to assist other groups and organisations in the community. Our intention is to take as broad a view as possible and help where we can. For example, we can provide specialist knowledge for model aeroplane and boat clubs interested in radio control.

"In this way, we believe we can make amateur radio better known within our community."

The EMDRC conducts AOCP classes on Friday nights. For details write to Ken Palliser, VK3GJ, EMDRC, PO Box 87, Mitcham 3132.

General meetings are held on the last Friday of each month, at 8.00 p.m. in the Mooroolbark Technical School, Reay Road, Mooroolbark. Nunawading branch meetings are in the Coffee Shop, Nunawading Civic Centre, on Friday night about the middle of each month.

ILLAWARRA BRANCH WIA: Dairy cows at Robertson, the location of the Illawarra branch repeater, took a liking to the plastic covering on the control wires, with obvious results. A working bee to bury the replacement set has been arranged and it is hoped to have the system operating again shortly.

Construction of the solid state transmitter and identifier is coming along nicely.

An intermittent open circuit in a coaxial connector prevented transmitter operation from VK2AMW during the E-M-E tests in April. However, JA1VDV was heard testing on 432.060MHz.

The transmitter has been modified by the installation of the K2RIW type final amplifier in place of the push-pull power amplifier. A new receiving system input coaxial filter has also been constructed.

Schedules on twenty metres are kept each Saturday afternoon with ZE5JJ to discuss the latest EME information.

Write to the secretary, PO Box 110, Dapto 2530 for details of branch activities.

MOORABBIN & DISTRICT RADIO CLUB: During the past 12 months there has been a healthy increase in club membership.

At the April meeting members were given an interesting talk by David Hull, VK3ZDH on the OSCAR satellite program. David explained the problems in commanding the OSCAR 6 and 7 spacecraft due to the odd hours of the night that the commands take place. To overcome this David built a minicomputer which can be programmed at more appropriate times to handle these chores.

Slides and photographs taken on his recent trip to the AMSAT conference were also displayed.

Meetings of the MDRC are held on the first and third Fridays of each month in the Moorabbin Baseball Club Rooms, Summit Avenue, Moorabbin commencing at 8.00 pm.

GEELONG AMATEUR RADIO & TV CLUB: Ideal conditions prevailed for the 1975 annual Hamfest at Geelong. Attendance was up on last year, particularly from family groups. Entertainment and contests were held for all tastes.

This year the club made available a special trophy called the "R. B. Wookey Memorial Trophy" in memory of Bob VK3IC. The trophy was awarded to Morry Daily, VK3BMD, for the best overall performance on the field contests.

At the annual meeting Mike Trickett, VK3ASQ, was elected president; Alan Bradley, VK3LW, vice-president; David Mann VL3ZMZ, secretary; Harold Selman, VK3CM, treasurer; Arie Green, VK3AMZ, as PRO; Dick Morrison, VK3VZ, technical officer, and Albert Gnaccarini property officer. The GARC club rooms are in Sterrer Street, East Geelong. Postal address, PO Box 520, Geelong 3220.

GOLD COAST RADIO CLUB: The club membership of 70 is an all time high and, as suggested in a recent GCRC monthly newsletter, "perhaps the largest radio club in Queensland".

The newsletter also reported that the Ipswich and Districts Radio Club repeater is fully operational on Channel 3 and has been interrogated by a few of the GCRC members.

There are vacancies at the AOCP classes held each Monday evening at 7.30 pm at 38 Australia Street, Broadbeach. Those interested in the novice licence will also be catered for.

To keep in touch with what is happening on the Gold Coast join the net at 1930–2000EST on the repeater VK4RGC or at 2000-2300EST on 3650kHz each Sunday. VK4WIG is control station. Enquire about the Gold Coast Awards.

CENTRAL COAST AMATEUR RADIO CLUB: The Central Coast Award, a handsome certificate, is given for contacts with operators in the Central Coast (Gosford and Wyong Shires combined). Overseas operators need only contact two stations in the area. Australian operators outside the Central Coast area must contact the club station VK2AFY and four other Central Coast operators.

Central Coast operators must contact the club station and ten other operators.

All applications to the CCARC, PO Box 238, Gosford 2250.

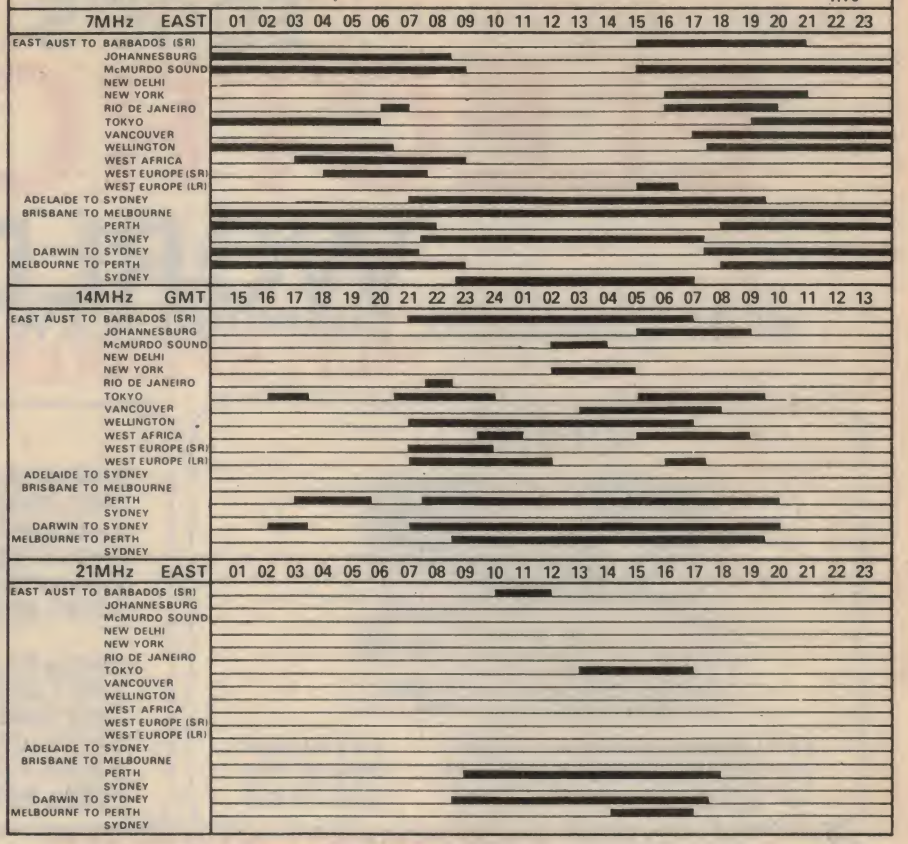
The latest addition to the CCARC channel 1 repeater, VK2RAG, is location information. After transmitting the call sign the repeater transmits the word "Kariong" in MCW. After the initial transmission the location will be given after every sixth call sign.

Another addition will be the transmission of the time in Morse code after every third call sign transmission.

Meetings are held on the first and third Fridays of each month in the clubrooms Dandaloo Street, Kariong. Visitors welcome.

IONOSPHERIC PREDICTIONS FOR JULY

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 7.75



Several YRCS students at a Saturday afternoon practical class conducted by the Westlakes Radio Club.

CAIRNS AMATEUR RADIO CLUB: General meetings of the club are held on the second Wednesday of each month, at 8.00 pm in the State Emergency Service headquarters building, MacNamarra Street, Cairns. Members also gather at the same venue at 10.00 am each Sunday morning for general discussion and training classes. All visitors and interstate amateurs are welcome to attend these meetings. Contact club president John Roberts on telephone Cairns 51 2244 (Bus.); 55 4430 (Priv.) or public relations officer David Warne on 51 2122 (Bus.) for further information.

AUSTRALIAN CAPITAL TERRITORY DIV. WIA: The convention held at Canberra over the Easter Holidays was very successful. The dinner was attended by 73 adults and 10 junior guests. Enjoyed by all.

A very represnetative display of amateur equipment was on view during the weekend and thanks are extended by the committee to the commercial houses for attending and the donations of prizes made available for presentation to the winners of various contests.

The postal address of the ACT division is PO Box 117, Canberra City 2601.

MAITLAND RADIO CLUB: Training program at the club will be divided into two terms each year. Examinations will be conducted in June and November each year.

Mr R. V. A. Johnson, of Adamstown, retired principal of the Maitland Technical College has accepted the position of honorary examiner and will mark the end of term examination papers.

Technical training is available to members each week and incorporates elementry classes for beginners through to advanced members preparing for the PMG Dept. examinations.

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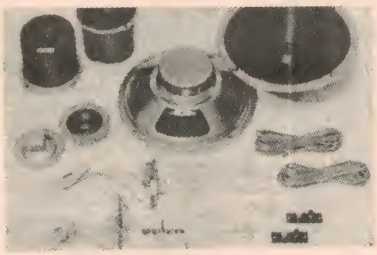

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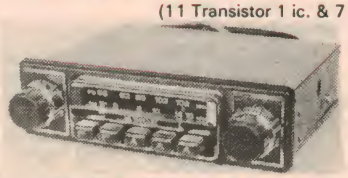

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Shortwave Scene

by Arthur Cushen, MBE

The broadcasts of Radio Canada International to the South Pacific have been retimed and are now heard from 0800-0900GMT daily on 5970 and 9625kHz. A tentative schedule from September 7, 1975, shows that the program will revert to 0900-1000GMT, as used previously.

Radio Canada in Montreal has been broadcasting to the South Pacific for nearly 30 years. For the first few months the broadcast was on Sundays only before being extended to a daily transmission. For many years the broadcasts were from 0830-0930GMT. However, last November the schedule was altered to the time of 0900-1000GMT, and this proved unsuitable for listeners when New Zealand and most states of Australia went onto Summer Time.

As from May 4, the schedule was again altered, and broadcasts are now heard from 0800-0900GMT. On Saturdays the last 30 minutes of the program includes The Listeners Corner and The Radio Canada Shortwave Club, which feature interesting items on reception. Also included are DX Tips and a series on foreign station interval signals. The address of Radio Canada is: PO Box 6000, Montreal, Canada.

McMURDO ON 7050kHz

The American Forces Antarctic Network has been heard on the new frequency of 7050kHz around 0700GMT. This station was first reported in July last year when using 6012kHz. A subsequent verification from the station stated they operated 24 hours a day and used the power of 1kW. The transmitter is located 5km from the studios at McMurdo.

Reception on the new frequency of 7050kHz is best around 0700GMT, with popular music and announcements every hour. Due to the location the transmission path is poor, resulting in difficult reception conditions.

SAHARA USES 100kW

A verification from Radio Sahara has advised us that the power of the transmitter has now been increased to 100kW. We made a request to the station for this information, as in the past the power has been taken as 10kW. This information is still not given on the official verification card, but was conveyed to us in a note from Radio Sahara.

A new verification card has been issued and this is a folder which shows a map of North Africa on one side and the verification details on the other. The station continues to be heard on 11805kHz from 0800GMT till 1800GMT, when a frequency change is made to 6095kHz for broadcasts through to 2400GMT. The address of the station is: Radio Television De Sahara, EAJ 202-203 Radio Sahara, Apartado 106, Aaiun, Sahara.

NEW GUINEA CALL CHANGES

Papua and New Guinea have dropped the prefix VL and VH from all their call signs, the shortwave service now using the new prefix P2. This means that VLK3 on 3925kHz is now being identified as P2K3. The medium-wave stations have dropped the figure 8 and 9 prefix and now identify as, for example, NBC Port Moresby. Other stations involved include Lae, Rabaul, Madang, Goroka, and Wewak.

The stations operated by the District Service have also dropped their call signs, and now use a slogan identifying the station with its location and the area it covers.

VILA EXTENDS SCHEDULE

Radio Vila in the New Hebrides has extended its schedule on 3945kHz and now closes at 1000GMT after a program in French. The station formerly left the air at 0915GMT. Earlier transmissions have been observed in English from opening at 0545GMT, while Pidgin is broadcast at 0800GMT. There are three transmitters in operation: YJB1 on 1420kHz which carries all programs, YJB7 on 7260kHz which broadcasts from 0030-0200GMT and YJB4 on 3945kHz which broadcasts from 0545-1000GMT. The address of the station is: Radio Vila, PO Box 110, Port Vila, New Hebrides.

FINLAND'S ENGLISH SCHEDULE

The Finnish Broadcasting Company has retimed its English transmission to North America and this is now broadcast from 2300-2330GMT, replacing 0300-0330GMT. A new transmission is heard from 0700-0730GMT on weekdays on 6145kHz, and on Sundays from 0730-0800GMT. Other transmissions are at 1400-1430, 1600-1630, 1800-1830, and 2030-2100GMT on 9550, 11755, 15185 and 21605kHz. The transmission at 2300GMT is on 15185kHz, while a relay of the Home Service is carried on 6120kHz on weekdays from 0330-2130GMT and from 0400-2130GMT on Sundays. Included in this transmission is the English program which is broadcast from 1400-1430GMT and from 1600-1630GMT. Transmitter powers for the various frequencies are: 6120, 15kW; 9550, 15kW; 11755, 15kW; 15185, 100kW and 21605 1kW.

RADIO FIESTA

Radio Fiesta in Mexico City, formerly Radio Tricolour, has been well received on 11880kHz up to 0400GMT. The station announces after each recording, and the same program has been noted on 15110kHz. However, this frequency is also used by the External Service of Radio New Zealand.

The station announces its frequencies in Spanish. Only one call-sign, XERH, is given, the same call-sign used by the medium-wave station on 1500kHz. Reception on 11880kHz is possible from around 0200GMT, but at 0400GMT there is severe interference from Ankara Turkey, which opens on the same frequency at this time.

COLOMBO DX SESSION

A new weekly DX Session is now broadcast in the All Asian Service of the Sri Lanka Broadcasting Corporation at Colombo. The program is compiled by Australian born Adrian Peterson, who hopes that his session of 15 minutes of news for DX Listeners will also be carried on the service to Europe and to Australasia. The increase in the listening hobby in Asia is reflected in this new program, which is one of the first in the Asian area. Radio Japan has, for many years, had its Sunday DX Corner in its service to the Pacific. This is broadcast at 1005GMT on 11875 and 15235kHz.

At the present time, the transmission from Colombo in which Adrian Peterson presents his DX Monitor International is not beamed to this area. However, it is hoped it will be used in the Australasian service in the near future.

HUNGARY'S NEW SERVICE

Radio Budapest in Hungary now broadcasts a special transmission to Australia and New Zealand from 1030-1100GMT. This service should give best reception during the summer months, although reception should be possible in Australia at all times on at least one of the frequencies being used. The broadcasts are carried on 7220, 9585, 11910, 15160, 15285, 17780 and 21525kHz. The transmissions to North America are giving better reception at their new times of 0200, 0230, and 0300-0330GMT when transmissions are on 6000, 7250, 9585, 9833, 11910, 15220, 17710kHz. A broadcast to Europe from 2130-2200GMT is available on 5965, 7250, 9655, 9833, 11910, 15125 and 17780kHz.

MEDIUM WAVE NEWS

AUSTRALIA: The latest ABC station to open is 3ZZ Melbourne operating on 1220kHz. According to Dick Whittington of Melbourne, the station opened on May 12, will operate between 0800-1300GMT and will carry programs with an open access for the first two hours.

The new Canberra commercial station 2CC is to operate on 1390kHz instead of 1210kHz as first announced. Broadcasts are expected to commence on August 1.

The Adelaide University Radio 5UV, operating on 530kHz, has now been heard to closing at 1330GMT, and on some occasions as late as 1430GMT.

NEW ZEALAND: A series of tests were recently carried out by 1YW Hamilton, operated by Radio New Zealand, using the frequency of 1143kHz instead of the assigned 1140kHz. This test was carried out to find interference possibilities with 2YX Nelson on 1150kHz. There is some suggestion that a closer allocation of frequencies is being considered, with a reduction from 10kHz to either 8 or 7kHz separation between stations.

LISTENING BRIEFS
EUROPE

BELGIUM: DX Corner Belgium is broadcast on the fourth Monday of each month in the English transmission from 2255-2315GMT on 9730 and 11855kHz. This is now repeated on the second Monday of the following month. The session is also broadcast from 0040-0100GMT on 9730 and 6055kHz.

DENMARK: Radio Denmark has had to dismantle some of its aerials, as they have been in service for many years, and is left now with only Rhombic and Curtain antennas. All transmissions are now carried on 15165kHz, except for a new transmission to North America at 0200GMT on 9520kHz.

SWITZERLAND: According to the BBC Monitoring Service, Switzerland has added an Arabic broadcast to its transmission beamed to Africa from 1045-1100GMT. Transmission frequencies are 21520, 17830, 17795, 15430kHz. The only broadcast in Arabic previously has been from 1730-1800GMT, with a general beaming to Europe, Africa and the Middle East.

AFRICA

CHAD: Reception of Chad on 4905kHz has been reported in New Zealand around 0600GMT. According to Ray Crawford of Invercargill NZ, the transmissions are shown on the schedule as 0430-0630GMT and 1130-2130GMT on week days, 0430-2300GMT on Saturdays, and 0430-2130GMT on Sundays.

SIERRA LEONE: Signals on 3316kHz have been noted by Stan Larking of Whakatane, NZ at 0700GMT when the station carried BBC World News. The broadcasts from Freetown are now carried on a 250kW transmitter, which is giving good reception throughout the Pacific area.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are in GMT. Add 8 hours for WEST, 10 hours for EAST, and 12 hours for NZT.

L.E. CHAPMAN

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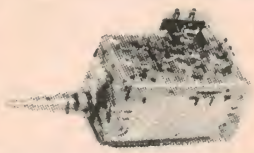
TV tuners new in valve type or transistor **$10** each.

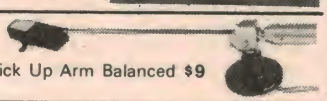


A.W.A.
Stereo Amplifier
and tuner solid state.
5 Watts per channel
$40 Pack and Post $1.50.
Interstate $2.

$5.00
Transistor Type
Power Transformer
245 Volt
36 Volt
18 Volt Centre Tap
6.3 winding

Super special B.S.R. record changer 12 inch turntable balanced arm cueing device etc. $35, pack and post **$1.00,** Interstate **$1.50.**

LEVEL AND BALANCE METERS
1200 Ohm
100 microamps **$2**



Stereo Pick Up Arm Balanced **$9**

Jack Plugs 6.5mm **50 cents**
3.5mm **25 cents**
R.C.A. Plugs **25 cents**

Battery Saver 240 to 6-7.5-9 Volt
6 Volt/300mA
9V 200 mA
$10

SLIDE SWITCH
3 position **50 cents**

Shure M 75/6 Magnetic Pick up Cartridge **$11.**

Picture Tubes
New 110 Deg 17 inch **$15**

100 mixed condensors micas polyester ceramic **$2** per pack and post **45c.**

Perspex tops for record players size 12 x 9⅜ x 3¼ **$1.50.**

Speakers M.S.P.

12 UAC 8/OHM 30 WATTS RMS	**$22.00**
12 TACX in 8 or 15 OHM 10 WATTS	**$11.00**
8 TACX 8/OHM	**$8.00**
6 x 9 in 8 or 15 OHM	**$7.00**
5 x 7 in 8 or 15 OHM	**$6.00**
6½ inch 8 or 15 OHM	**$4.50**
8 x 4, 8 or 15 OHM	**$4.50**
6 x 4, 8 or 15 OHM	**$3.50**
5 x 4 15 OHM	**$2.50**
4 inch, 8 OHM	**$2.75**
4 inch large magnet 15 OHM	**$3.00**
3 inch 3.5 OHM	**$2.50**
5 inch Tweeters 8 OHM	**$3.50**
4 MB Tweeters	**$5.00**
6 inch Dual Cone Tweeters	**$6.00**
5 x 3 80 OHM	**$3.00**
5 inch magnavox dual cone 8" 27 OHM	**$6.00**
8 inch national built in Tweeter	**$14.00**
rola custom kit 63G x Tweeter C60 woofer cross over and pot	**$19.00**
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Magnavox 10 inch 4/ohm	**$6**
3 inch 8/ohm	**$1.50**

Indoor TV Aerials Vertical Spiral **$1**

Mixed Tag Strips **50 cents** for Dozen

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Top quality suit most recorders **$5.00**

Jack Plug Sockets 6.5mm **35 cents**

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BSR Ceramic Cartridge Stereo **$4**

250 mixed screws. BSA, Whit self-tapper bolts, nuts, etc. **$1.25** bag plus **40c** post

Speaker 4 pin plugs **15 cents**

25 mixed 5 and 10 Watt resistors **$2.00**

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$5.00

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Pots 30 mixed values including ganged and concentric **$5**

In Line Fuse Holders **20 cents**

Stereo Speaker Wire **12 cents** yard

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100 mixed condensors micas polyester ceramic **$2** per pack and post **45c.**

Electros 3 in one 100-25-40, 24-250-300, 50-250-300 **75 cents.**

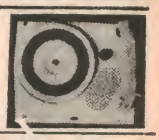
Electros 100 MFD 400 Volts **$1.00**

Speaker transformers 12,000 to 15 OHM **$1.25**

½ Meg Double Pole Switch Pots **50 cents.**

Coaxial TV Feeder Cable 75 OHM **30 cents** yard

Transistor 7 Radio ready to use with battery holder **$3.75**



BSR 4 speed 240 V Gram Motor and Pickup $7.95

BSR Stereo Player Model P-128 $52 pack and post **$1.50** Interstate **$2.00**

TV Aerials Complete Range
Hills Colour $12 to $60

BSR Mini Changer 4 speed **$19.00**

Screw in 6 Volt Pilot Lights **$1.50** for 10
Plug-in type 10 for **$1.00**

INFORMATION CENTRE

ULTRASONICS: I have a number of enquiries to make about the ultrasonics project in "Electronics Australia" of February 1974. In the transmitter, can a BC107 be used in place of a BC108 and do they have the same lead layout? Does the high power transmitter require a connection to the case? If so, where does it come from? (The text says the outside of the transducer touches the case, yet it shows no lead on the schematic to case).

If the set-up does not work when finished, how can you tell if the trouble is in the receiver or transmitter? (K.P., Kingswood, SA).

Yes, BC107 can be substituted for BC108 in this circuit and their lead layouts are the same, if made by the same manufacturer. Since the oustide of the transducer touches the case, no other connection from any part of the circuit is necessary or desirable.

If the set-up does not work, the output of the transmitter can be checked with the aid of an oscilloscope or multimeter with a good frequency response. Just measure the AC voltage across the transducer (use a DC blocking capacitor of at least 0.1uF if your multimeter does not have one). You should get about 4.5 volts for the low power transmitter and about 9 volts for the higher-power transmitter.

FUSE BLOWING: I have a Playmaster 132 stereo amplifier which constantly blows fuses. I can switch the amplifier on and it works normally. I then switch it off and then on again and often the fuse will blow. I can't seem to find any shorts anywhere. Could there be an initial surge of current when I first switch on? Hoping you can advise me what I can do to rectify the problem. (R. H., Kirribilli, NSW).

A number of readers have asked about this problem. In fact there is nothing wrong with the amplifier. In any piece of equipment with a large transformer, it is difficult and sometimes impossible to select a fuse which will protect the equipment against overloads and faults but not "blow" with the initial surge current. Normally, the fuse in the Playmaster 132 does not blow unless a fault develops.

However, when you switch it off, the transformer can produce a large back-emf (in other words, a high voltage, perhaps much higher than the peak of the mains voltage) which can then interact with the incoming mains voltage at switch-on (if it is switched on rapidly enough after being switched off) to produce a very heavy surge current. Naturally the fuse blows. The solution is simple: do not switch the amplifier on and off repeatedly. Just why anybody wants to do this anyway, escapes us.

DE FOREST VALVES: Amongst a stack of old valves given to me many years ago by an old amateur, including a lot of 4 pin base types and 26 base types, there were a couple of No. 13 base types CRC 955. What are these?

There is also a very odd valve (Osram S625) with two bakelite ends, three spring pins on one end and two on the other. There is also a huge 4 pin Osram type coded either D625A or P625A. I also have a brand new Cossor in a carton labelled 625P.

Lastly, I have an old and battered tin can (empty) printed as shown:

DE FOREST (Reg Pat Off)
Audion Dry Cell Type DV3
Detector and Amplifier
De Forest Radio Co., Jersey City, N.J.

I guess that some of these items may be of interest to collectors. (R. Lockerbie, Merimbula Nurseries, Merimbula 2548, NSW)

Unfortunately, we are unable to help with any details of these valves, but we have printed your full name and address so that interested readers may contact you direct.

LSI DIGITAL ALARM CLOCK: Could you please answer the following questions about the LSI Digital Alarm Clock featured in the December issue. 1. If a 4 digit display was used and the rotary switch was on "seconds display" could a 35 minute 59 seconds or 59 minute 59 seconds display be generated by the chip? 2. If a 4 digit display was used could a full 24 hour display be obtained? 3. If a 4 digit display could be used would the AM and PM indications be able to be sutstituted with say a red and a green LED? (K.J., Condell Park, NSW.)

It would be possible to use a 4 digit display with the MM5316 chip, but this would necessitate a complete redesign of the printed circuit boards. If this was done, the seconds display would still be as described in the article. A full 24 hour display would be obtained, but the AM and PM indications would no longer exist, as these are in fact driven from the tens of hours digit. In any case, they would seem to be pointless with a 24 hour display.

SOLAR HEATER: I wish to query the article entitled "NASA Develops New Solar Panel Coating" as presented on page 41 of the July 1974 issue. The article states that the new coating absorbs 93pc of the heat energy available, but re-radiates only 6pc of this energy. Since good absorbers of radiant energy are also good radiators (and vice versa), this statement would appear erroneous.

Consider the following system: an aluminium panel with the new coating is hung in a room with no windows to allow radiant energy to enter. Infra-red radiation from the walls and objects in the room will be incident upon the panel. Since only 6pc of this radiation is re-radiated, the panel will become warmer than room temperature, thus setting up a convection current to cool the panel and transfer heat towards the ceiling.

If the room was totally sealed so that no energy could enter or escape, the convection process would continue indefinitely, giving rise to a kind of perpetual motion machine. As a perpetual motion machine is not possible, I realise that there must be a flaw in my line of reasoning somewhere.

Finally, in your October issue you advertised a handbook entitled "Projects and Circuits," but give no indication as to which circuits the book contains. I wish I had known that you were going to publish the Playmaster 143. I have just received the Playmaster 136 ki' and have not yet finished putting it together. Would it be possible to publish details on how to update the Playmaster 136? (R.F., Vasu Patrol Post, New Guinea.)

We have abbreviated your letter somewhat R.F., but retained its essential points. Yes, there is a flaw in your line of reasoning. What you have failed to appreciate is that the figures supplied are valid only because most of the heat absorbed by the panel is transferred to water circulating through the panel. In other words, the figure of 6pc represents the percentage of energy lost through re-radiation from the panel. The water circulating behind the panel acts as a form of "heat sink", transferring heat away from the panel for storage.

This heat energy is then tapped off for use, ie the system is open ended in that energy is continuously being fed in and used.

The "perpetual motion machine" system proposed by yourself is not a valid analogy in that it is a closed system. Under these conditions, the panel will simply behave like any other "black body," its emissivity increasing with temperature until the amount of energy re-radiated is equivalent to the amount of energy absorbed, thus stabilising the temperature. In the system proposed, this temperature will be room temperature.

The types of circuits published in the handbook are too numerous to list here. However, we may be able to indicate some of these in a future advertisement. The Playmaster 143 is essentially an updated version of the PM136, and most of the modifications involved can be easily incorporated into the earlier design.

MAGAZINE LAYOUT: Having limited magazine storage room at home, I am forced to cut out and keep only those projects and articles of interest, rather than the whole of the EA issue. However, in almost every issue I find articles that I wish to keep occur "back-to-back", and cataloguing of projects for easy reference later becomes impossible.

Would it be possible to lay out the magazine such that projects at least are separated by a page of advertising. I am sure there would be many other people who would appreciate this arrangement.

Apart from this gripe, the magazine is excellent, and over the past two years I have had many interested enquiries about the Musicolor II that I built and have found perfect for mood lighting at parties. As with others, a most commendable project. (P.B. Concord, NSW)

Your criticism is not new P.B., and has been raised many times in the past. And while we agree that

(Continued on p.107)

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

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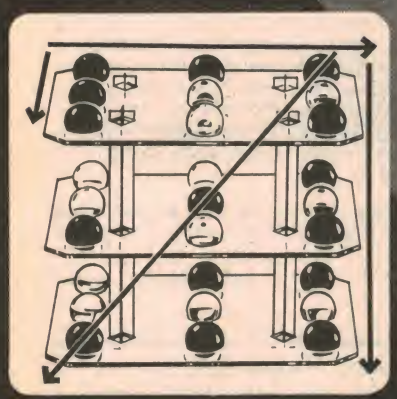

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INFORMATION CENTRE

(Continued from p.105)

it would be more convenient if editorial pages were separated by a full page advert, in practice this situation is virtually impossible to achieve. We would refer you to the Forum pages of the January 1974 issue of EA, where we answered a previous critic in some detail. Thank you for your suggestion and your kind remarks.

LOW FREQUENCY RESPONSE: I am 15 years old and have been interested in electronics for about 2 years now. I must congratulate you on a clearly set out and informative magazine. I have recently built the PM 136 amplifier and thanks to the simple instructions and clear diagrams managed to get it operating first go.

I connected the amp to a turntable fitted with a suitable cartridge and a pair of speakers, and I am extremely pleased with the resulting sound.

As I operate the set in a very small room (about 12' x 9'), it requires a fair degree of bass lift to achieve a "flat" sounding response. This, however, dramatically increases turntable rumble as well as low frequency surface noise to a very large extent, causing the woofer cone to travel about 2" excursions at half volume setting.

Is there any way of attenuating the response below about 20Hz without major circuit changes to the amplifier? It seems to me that this must be quite a common problem, so I am hoping you can answer this in the pages of "Information Centre". (N.G., Carlingford, NSW.)

Thank you very much for your comments about the magazine. It is possible to design circuits to roll off the bass response at 20Hz, although we have never presented such a design. From the description of your symptoms, it appears that you may be suffering from acoustic feedback between the speakers and the turntable unit.

A simple test for this is to move the turntable to another room. If the large cone excursions stop, it is almost certain that acoustic feedback was the cause of the excursions. It will now be necessary to return the turntable to the original room, while still retaining the acoustic isolation.

It may be necessary to increase the isolation by providing extra suspension for the plinth, or by placing it on some sort of flexible mounting, similar to that used to support the turntable on the plinth. Another approach is to use a wall shelf to support the plinth and turntable, to avoid coupling of vibrations from the floor.

If acoustic feedback is not causing your troubles, then there is little which can be done. A high pass filter with a cutoff frequency at 20Hz will not eliminate any audible rumble and surface noise. However, it may eliminate distortion caused by bottoming of the woofer cone due to large subaudible signals.

Any filter with a higher cutoff frequency will eliminate rumble and surface noise, along with any signals which have similar frequency components, and for this reason is not recommended. We can only suggest that it may be necessary to use less bass boost.

LOST IN CAVES: An idea occurred to me while listening to the current record "Journey To The Centre Of The Earth" concerning a possible project. Two people had become separated while exploring a cave but were able to find each other and determine their distance apart "by use of their chronometers". I expect this was done by measuring the time lag between their speech.

I have thought out a way in which this idea could be implemented (details enclosed), and was wondering if this could possibly form the basis of a project. (Tony Picone, 99 Rowena Street, Richmond, Vic. 3121).

Due to the rather specialised nature of the device you have in mind, we do not think that it would be suitable as a project. However, we will keep your idea in mind. We have published your full name and address so that any interested readers can contact you direct.

DIMMER BUZZ: Recently, I had an opportunity to tape an amateur stage show at a nearby hall. Lighting for the stage was dimmed by modern solid state triac control using all three phases of the electricity supply. The result was a quite troublesome buzz throughout the whole length of the recorded programme except for the start when the lights were not working. The microphone leads were 12 yards long, of shielded cable.

My questions are: Was the interference induced through the input to the tape recorder via the microphones and long leads or via the mains supply which the tape recorder and light dimmers were connected to, or both of the above? How can I eliminate the problem on future occasions? Thanks for an interesting magazine which is well worth the price. I never miss a copy. (T. P., Richmond, Vic).

It is quite likely the buzz you experienced was radiated via the supply lines as RF interference which could be induced directly into the mic cables or picked up directly by the tape recorder. In addition, the mains interference could be fed directly into the tape recorder via its power supply. Without being in a position to eliminate each possibility, it is not possible to nominate the principal cause. As a first suggestion, 12 yards of cable is rather long unless you are using low impedance microphones and/balanced input connections.

DEAD LETTER: We are holding material originally addressed to Mr D. Shropshall, PO Box 216, Roebourne, W.A. 6718. This has been returned by the postal authorities, presumably because they could not deliver it. If Mr Shropshall will advise us of his present address we will forward the material to him.

(Continued on p. 110)

NOTES & ERRATA

PHILIPS 10GHZ DOPPLER MODULE (May 1975): The circuit of the prototype intruder alarm should show the 100k load resistor of the BC109 preamp transistor connecting to the 8.2V supply rail, not to the 10V rail.

EDUC-8 computer—from page 73

For slightly better results, it is necessary to measure the actual output frequencies of the XR-2206, using a digital counter. These will probably be slightly different from the nominal figures, due to the effect of component tolerances. Then work out the mean of the two frequencies, by adding them together and dividing by two.

Finally, set the free-running frequency of the XR-2211 to this mean frequency, in the following manner. With the power off, disconnect the 033uF capacitor from pin 3, and connect a temporary link between pins 2 and 10. Then turn on the power, and with no tone input signal, connect the digital counter to pin 3. Adjust the 5k pot until the counter indicates the correct mean frequency. Then turn off the power, and restore the circuit as it was. The XR-2211 should now give very clean and reliable demodulation of the FSK recordings.

Note that the XR-2206 device requires a 12V power supply rail, so that a small rectifier circuit must be added to the interface power supply as shown. The XR-2211 operates from the 5V computer rail.

In closing, it might be worthwhile to point out that the simple FSK modulator-demodulator or "modem" of Fig. 5 could also be used for transmitting data signals over radio links.

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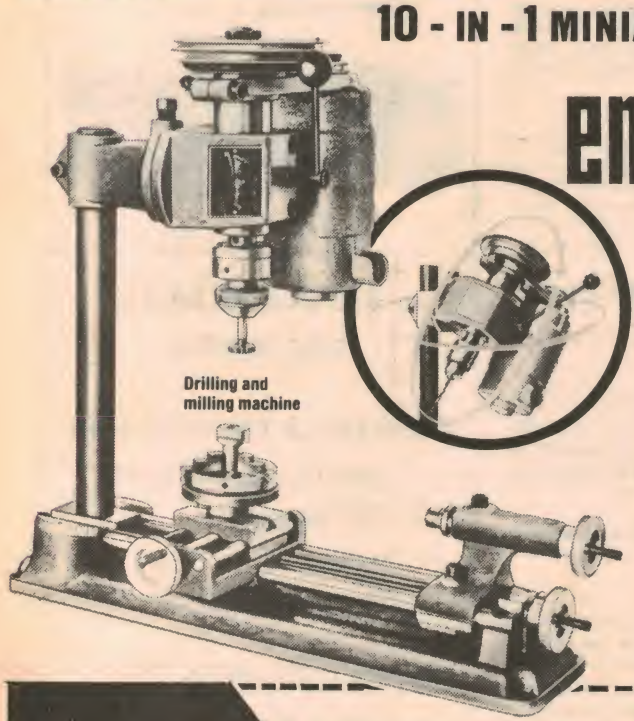

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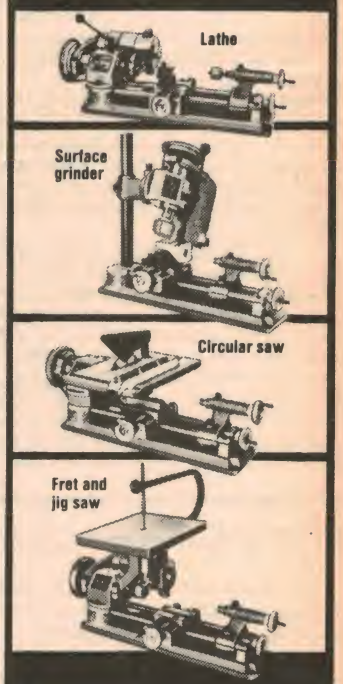

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THIS MONTH'S SUPER SPECIALS FROM MICRONICS!!! IS188 (OA90) GERMANIUM SIGNAL DIODES—10 for 80c, BC557 (BC177, BC157)—10 for $1.80, BC558 (BC178, BC158)—10 for $1.80, BC559 (BC179, BC159)—10 for $1.80. STOCK UP NOW!!! GIMA RECTIFIER equivalent to EM410 (1000V, 1A) (A Superior Glass type)—10 for $2. ELECTROLYTICS Pigtail 16uf (300V)—10 for $2. THE ABOVE SPECIALS are of limited quantity only and will be sold out. TAKE Advantage of these LOW PRICES BEFORE YOU MISS OUT. STOCK UP NOW!! TRANSISTORS AT INCREDIBLE PRICES; BC328—10 for $2, AS205 (BC107)—10 for $1.50, AS147—10 for $2. DIODES: EM402—10 for $1.20. INTEGRATED CIRCUITS at GENUINELY BARGAIN PRICES—DIGITAL T.T.L. 7400, 7401, 7402, 7410, 7420, 7430, 7440—40c ea., 7404—45c, 7408—50c, 7413—80c, 7473, 7474, 7475—$1.05 ea., 7441, 7442—$1.75 ea., 7447—$2.20. LINEAR OP AMPS 709 (D.I.P.)—80c, 741 (D.I.P.)—85c. AUDIO AMP PA234 1wR.M.S. (incl. Cct Diagram)—95c ea. COPPER CLAD BOARD—6"x3"—5 for $1. VALVE SOCKETS (7-pin)—10 for 50c. SLIDE SWITCHES (18-pin)—4 for $1. TUNING CAPACITORS—Larger type 2-gang—$1.50, 3-gang—$1.75. ELECTROLYTICS AMAZING DISCOUNTS: Top quality Pigtails 47uf/10v—10 for 60c, 2uf/40v—10 for 90c, 2uf/300v—10 for $2.50, 10uf/65v—10 for $1.20. 40uf/70v—10 for $2, 50uf/125v—6 for $2, 100uf/200v—3 for $2, 200uf/70v—4 for $2, 1000uf/6.5v—6 for $2, 1000uf/18v—5 for $2, 2000uf/18v—4 for $2.50. SUPER BARGAIN PACKS. A MUST FOR THE AMATEUR, HOBBYIST or SERVICEMAN. THESE are assorted mixed packs at sometimes ¼ of the normal price. POLYESTER CAPS: All 10% Tol. in volt. of 160v, 270, 400v (Mixed)—100 for $3. RESISTORS: Mostly 5%, 10%, ½w, 1w, No Short Lead Rubbish (Mixed)—100 for 90c. TRANSISTORS, NEW, BRANDED pnp and npn germanium types (Mixed)—10 for $1.75. POWER RESISTORS: 3w-7w, 5%, 10%. Top quality (Mixed)—25 for $1.75. ELECTROLYTICS: Top quality Pigtails incl. low volt. and high volt. types—25 for $1.90. CERAMIC CAPS: Excellent quality low and high volt types—50 for $1. TANTALUMS: Miniature types at incredible price of 20 for $1.90. ZENER DIODES: (Mixed) 400mw 1w, 10w types—10 for $2.95. TAG STRIPS: (Mixed)—40 for $1.95. COILS: Miniature coils Osc. I.F. (Mixed) unmarked—20 for $1.50. STYROSEALS: Including 630v types. Top grade—25 for $1. POTENTIOMETERS: Including dual, single, switch and preset pots—20 for $2.95. SWITCHES: Including rotary, slide and P.B. switches. Real value—10 for $3.50. SILICON DOUBLE DIODES (20v, 30ma) TD772, ideal for making up "AND" GATES—20 for $1. .001uf/100v Polyester Greencaps—20 for $1. .01uf/100v Polylester Greencaps—20 for $1.20. FEED THROUGH CERAMICS 1000pf/350v—10 for $1. Post and Pack 30c or extra for heavy parcels. MICRONICS, P.O. Box 175, Randwick, N.S.W. 2031.

TAUT BAND MULTIMETER 34 ranges 20,000 ohms/volt, AC & DC current to 3A, 4 resistance ranges rechargeable battery. Price $25.50 plus tax. Product USSR Technical & Scientific Eqpt. Co. Pty. Ltd., Box 241E, GPO, Melbourne 3001. 602 1885.

RECHARGEABLE ELECTRIC TORCH, plug in mains. Recharge 500 X $6.50 p.p. 50c. ACE Co. Box 24, Elizabeth 5112.

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CLOSING DATE is six weeks prior to the on-sale date. Issues are on-sale the first Monday of each month.
ADDRESS all classified orders, copy, enquiries, etc. to: The Advertising Manager, ELECTRONICS Australia, Box 162, Beaconsfield, 2014.

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280 LONSDALE STREET. MELBOURNE, 3000
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THIS MONTH'S SPECIAL

Solid State R.F. Amplifiers brand new in carton with manuals. These amplifiers are the size of a car radio.

SPECIFICATIONS: 4 watts max input, output 25 watts, output impedance 50 ohms. The line up of these units is as follows: All units are modules namely RF Keying Module, Automatic Power attenuator, Input attenuator, A.L.C. Driver Final—all push pull. Low Pass Filters, Directional watt meter, antenna matching network. Frequency range 30MHz to 75MHz 24V D.C. operation.
Size 11 x 7 x 2½". Price only $45 P/P $3.

BARGAIN: Transistors unmarked mixed $2.50 per 100 P/P 40c.
QQE06 Ceramic Sockets $2 each P/P 40c
Crystal Filters 10.7MHz 30KHz $5 each P/P 75c
Ceramic Filters 455 KHz 25c each P/P 15c
Resistors mixed $1.50 per 100 P/P 40c
Capacitors mixed $1.50 per 100 P/P 40c
Small A.C. 240 volt motors 6 R.P.M. $5 each P/P $1

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LANTHUR ELECTRONICS

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ELECTRIC MOTOR SPEED CONTROLLERS

Suitable for ac/dc brush type motors only. Especially suitable for hand tools. Complete ready to use and approved by the S.E.C. Controls speed down to stop without loss of torque.

Two amp. 500 watt size	$15.75
Ten amp. 2400 watt size	$25.00

Prices include certified post.

DIODES—High quality miniature glass type. 400 piv @ 1 amp.

Six for	$1.00
Twenty for	$2.50

Price includes postage.

AMMETERS—Moving coil. 0 to 10 amp. dc. Clear face 65 x 55 mm. $4.50

Price includes postage.

BATTERY SAVER BASIC KIT

Replaces batteries in radios, tape recorders, record players, toys, etc. Consists of tapped transformer, bridge rectifier, filter capacitor & circuit. Will supply dc voltages from 6 to 15.

One amp. size	$7.95
Plus pack & post	0.50
Two amp. size	$13.50
Plus pack & post. Vic.	0.75
Other	$1.50

Excess postage will be refunded.

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Will control incandescent lamps from full to out. Capacity 1000 watts. Consists of triac, diac, pot, knob, ferrite rod inductor, caps. & circuit.

Price includes postage. $6.50

BASIC ELECTRIC MOTOR SPEED CONTROLLER KIT

Suitable only for ac/dc brush type motors. Consists of triac, resistor, pot., knob, diodes, 3 pin base & plug. & circuit.

Three to four amp. capacity	$7.50
Ten amp. capacity	$8.50

Price includes postage.

BASIC BATTERY CHARGER KIT

Charges 12 volt batteries at 2 amp. Consists of transformer, bridge rectifier, ballast resistor and circuit. $8.50

Plus pack & post. Vic.	0.75
Other	$1.50

Excess postage will be refunded.

BROADCAST BAND TUNER

Complete ready to use. Open chassis with straight line dial and eight inch ferrite rod antenna. Band width 8kh., output half-volt. Supply voltage required —9 at 5ma. Suitable for use with Hi-Fi amplifiers, tape recorders, etc. $27.50

Price includes certified post.

	1-9	10+
Battery		
clips suit 216	10c	79c/10
holders square or long 4x1015	40c	30c ea
9v battery	40c	35c ea
Clips		
Alligator	12c	95c/10
Capacitors-electros pigtail/PC mtg		
.47mfd-47mfd 25v	13c	1000mfd 25v 60c
100mfd 25v	18c	2200mfd 25v 90c
220mfd 25v	18c	4700mfd 16v 1.00
470mfd 25v	35c	electros in 100 mixed
Ceramics		
1pf-.047mfd	9c	80c/10
.1mfd	12c	1.00/10
Greencaps 100v		
.001mfd-.056mfd	14c	1.20/10
.068mfd-.22mfd	18c	1.50/10
.27mf-.47 200v	22c	2.00/10
1mfd 200v	55c	4.50/10
2.2mfd 200v	1.00	8.00/10
Tantalums		
.47mfd-100mfd 25c less 20% for 20 plus (mixed)		
Electro packs		
25v elect 2 of each 1uf-220mfd total 18 capacitors	2.30	
Feed thru		
.001mfd (1000pf)	25c	2.00/10
Micas		
up to ½% and up to 1Kv		
to 100pf	25c	
to 1000pf	30c	
to 4700pf	35c	
Fuses		
3AG	12c	

All Fergurson transformers, valves, cable available

Meters
0-1mA 2" square $6.50

Kits
Transistor tester kit as EA $12.50
add 2 extra channels to your hifi $5

Resistors
¼w, ½w 3c $2.50 per 100
1w 6c $5 per 100
5w-10w 35c $3 per 10

	Plugs or line sockets		Chassis sockets	
	1-9	10+	1-9	10+
3.5mm large cover	20c	18c	15c	12c
RCA	22c	18c	18c	15c
PMG mono	42c	35c	33c	22c
PMF stereo	62c	45c	44c	38c
2 pin Din	25c	20c	15c	12c
5 pin Din	40c	35c	25c	20c
RCA twin			30c	25c

3.5mm small covered plug 12c or $10 per 100
Soldering irons—scope std $9
—transformer $12.50
—Soldervac de-soldering tool $6.75
Drill 12v Expo $30 with 20 ass tools

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BC107/8/9/147/8/9 22c
BC157/8/9/177/8/9 25c
BFY50 75c
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EM404 18c $14 per 100
IN914 10c $8 per 100
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OC28 $2 AD161/2 $2.75 pr
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2N3638A 40c 7400 ICs from 25c

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Heathkit IM-1202 2½-Digit Multimeter Kit

KIT $85.00 + P&P

- Bright 2½ digit cold cathode tube readout.
- Measures AC & DC voltage, AC & DC current, resistance.
- Excellent accuracy.
- Three terminal floating input.

State-of-the-art digital circuitry and readout, rugged portability and versatility . . . at unbelievable kit-form savings. The Heathkit IM-1202 Digital Multimeter has 1% accuracy on DC volt ranges, 1½% on AC volts and AC-DC current, 2% on ohms.

Trio Kenwood solid state communications receiver $335 P/P $4.

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Model XCR-30 Mk II 500kHz to 31 MHz continuous coverage, crystal controlled reception of AM/USB/LSB/CW. Price $260.00 + P&P.

IC PRICES SLASHED

DIGITAL TTL

Internationally known brands 1st grade devices at new

ROCK BOTTOM PRICES

7400	50c	7447	2.24
7401	50c	7473	1.10
7402	50c	7474	1.10
7404	54c	7475	1.10
7408	56c	7476	1.20
7410	50c	7490	1.25
7413	85c	7492	1.52
7420	50c	7493	1.50
7430	50c	74100	2.95
7441	2.20	74121	1.25
7442	2.00	74141	2.98
		74192	3.50

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709C	Operational Amplifier	1.15
710C	Differantial Voltage Comparator	1.25

MARKETPLACE — Cont.

HOBBYIST PRICED COMPONENTS SN7400—30c. LEDs: Min. red—21c, Jumbo red—28c or 4 for $1.00. Jumbo grn. or yellow—47c. Bridge rectifiers: 1Amp 100v—67c. 1N4148 diodes—10c. Zeners: 5% 400mW 3v to 33v—24c ea. REED switches with magnets: 40c ea. or 4 for $1.50. SAE for full price lists including electrolytics, transistors etc. P & P: 35c. Return mail service. DIGGERMAN ELECTRONICS, Box 33, Coramba 2466.

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C 12 P—$19 X30—$10
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Full range available. Please add freight. Ram Elect. 14 Charles St, Cheltenham, 3192. 93 6299.

NOVUS MATHEMATICIAN 4510 immed. del. $81 p.p. Stud T/ex avail. also. Norstate Electronics, Box 582, Shepparton, 3630.

DISPOSALS SALE at Studio 20 store, 367 Bourke St, Darlinghurst. Specials list from Box 5043, G.P.O., Sydney 2001.

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SPEAKER SYSTEMS BUILT. Choose from 3 basic systems or design your own. Extension speakers also. For full details plus prices ph. 524 5586.

INFORMATION—from p. 107

PLAYMASTER 143: In the article on the PM143 amplifier in the October issue, the transistors quoted in the parts list and circuit of the magnetic preamps are BC109 and BC108, whereas on the board layout they are the selected gain types BC109C and BC108B. Looking back, the PM136 used the selected gain types. Could you please inform me which is correct. (A.M. Auckland, NZ.)

It is preferable that selected gain transistors be used in the magnetic preamp of the PM143. However, it may be difficult to purchase these and, in practice, most BC109s and BC108s (and their equivalents) should perform satisfactorily. If you wish to obtain optimum performance, then the transistors should be selected for beta.

SLOW SCAN TV: I think you have a very good magazine at a reasonable cost and I look forward to it each month. Have you published any articles on Slow Scan TV, and on communications type receivers covering VHF and possibly UHF bands, employing either valves, transistors or integrated circuits. Would you please print my name and address so that any SSTV enthusiasts who may care to help me can write or otherwise contact me. (P. Black, 48 Swallows Crescent, Norlane 3214 Vic.)

Thank you for your comments about the magazine. A Slow Scan TV Monitor was presented in May 1974 (File No. 6/SSTV/1). A 432MHz converter was described in January 1972 (File No. 3/CV/7), and a Basic VHF Converter was presented in August 1973 (File No. 3/CV/11). The VHF converter is designed to be used with the 130 Receiver described in April and July 1972 (File Nos. 2/SW/62 and 2/SW/63), while the 432MHz converter is designed for use with a normal B&W TV set.

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32 piece metric brand new ½", ⅜" + ¼" drive ratchet ext bar, T bar plug spanner etc in metal case only $5.95 set. Post A 95c, B $1.10, C $1.25, C $1.35.

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3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included
from $1.60 each
P & P 20c.

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Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$29.50
(2 TELEPHONE SETS)

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Post: A $1.50, B $1.60, C $1.95, D $2.75.

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Types TR 1934 100-125 MHz and TR 1936 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. $33.00

MINIATURE ELECTRIC MOTORS

1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
75c each or 10 for $5
P & P 20c ea. or 10 for 55c.

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AN URM 32 A 120 KHz to 1000 MHz, with two 40V power supply, $125.00. $1.00 cartage to rail, freight payable at nearest attended railway station.

ILFORD 17.5 mm SPROCKETED MAGNETIC TAPE

1000 ft reels brand new original packing $4.00 ea. quantity available
Post A 79c, B $1.20.
C $1.40, D $1.70

No. 62 TRANSCEIVER

With headphones, accessories etc.
$60.

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1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

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Genuine ex-army Mk 3, liquid damped, as new $35.00 P & P $1.05

MORSE KEY	MORSE KEY BUZZERS
$1.40	$4.25
Post 20c.	Post 55c.

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Top Grade 2400' on 10½" reels. Ideal Video Experimenting. Only $3.50 per reel.
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C. $1.95, D. $2.75.

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4 bank 25 position $4 each.
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100KHz 20MHz $95

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50 volt DC, suit slot car Lap counters, etc.
$1.25 each. P & P 30c.

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Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7/16inch.
ONLY $9.95.
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1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
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BC221

Frequency Meters.
$35.00

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Produces an Audio Signal in rich harmonics. Ideal for Sig Tracing in A.F., I.F., and R.F. circuits. Powered by 4 Penlight Batteries with On-Off Switch and indicator lamp. Size 1½" Diam. 5" Long. Only
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45c P & P 20c

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25 x 30 $19.95 — 40 x 40 $28.95
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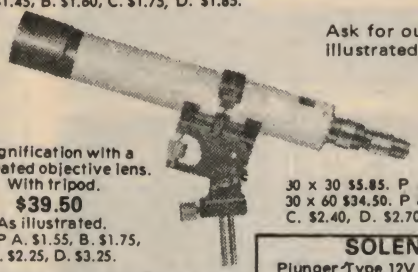

60 magnification with a 60mm coated objective lens. With tripod.
$39.50
As illustrated.
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30 x 30 $5.85. P & P 55c.
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2-way radio, 7 transistor, PMG approved, set of 2 only $49.50

1 watt, 11 transistor $130.00 set of 2.

P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

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3in x 2in containing 2 valves, qty. of resistors, etc.
ONLY 75c P & P 30c.

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Austronic type DFC-4 240V 50 cycle 0-100KHz $150

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New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5"

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1"	$26.50
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P & P A. $1.45, B. $1.60, C. $1.75, D. $2.

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2-16 M/cs. $65.
Transmitter No. 11 suits 210 $35.
24 volt Power supply to suit above $15.
Or complete station with Headphones, Mic. Morse Key, Antenna $110.

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C60 Low Noise Cassettes
$1.20
C90 Low Noise Cassettes
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Post 33c.

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POSTAGE KEY:-

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B: Vic, Qld, S.A.
C: Tas.
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807	$1.50	CV850	$1.50
6SN7GT	95c	1H6G	75c
5U4G	95c	832	$5.00
EF50	75c	6AG5	80c
5Y3	$1.99	6X4	$2.25
2 x 2	75c	VR64	75c
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P & P 30c

PARABOLIC REFLECTORS PYREX MIRROR

36" dia. Ideal solar radio optical experimenting also decorating purposes. $37.50 Sorry shop sales only.

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X BAND WITH KLYSTRON ETC. $45.00

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Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio. etc.
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200 MA 24 volt, ⅛in push movement.
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No. 19 TWO-WAY RADIOS.
Power supply, accessories, etc., $35.

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PRISMATIC Coated Lenses. Brand new. Complete with case.

7 x 35 Wide Angle	$35.50
8 x 40 Wide Angle	$39.50
7 x 50	$31.50
10 x 50	$32.50
12 x 50	$33.65
20 x 50	$37.95

P & P A. $1.45, B. $1.60, C. $1.75, D. $1.85.

3000 TYPE RELAYS

P.M.G. 200Ohms — 1'500Ohm Coils $2.50 each. P & P 30c.

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8 x 17 mag size of a rifle cartridge extends to 8" Only $3.50 each, post 55c.

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SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
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1½" Diam. 1½" FL 75c.
1½" Diam 4½" F.L. 75c.
P & P 20c

MULTIMETER

A compact and handy tester for workshop or lab where quick circuit checks are required
DC Voltage 5-2.5K (20,000 OHMS per volt) AC Voltage 10-1000V (10,000OHMS per volt) DC Current 0-50 UA. 0-2.5 MA, 0-250 MA. Resistance 0-6 Megohms Capacitance 100 UUF to 1UF. Decibels — 20 to plus 22 DB. Complete with instructions.
Only $15.95 ea. Post $1.05.

EX ABC RECORDING TAPES TOP BRANDS

¼" x 1200' on 7" reels. $2.50
¼" x 2400' on 10½" reels. $4.95
P & P A. 72c, B. $1.05, C. $1.15, D. $1.30

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E.M.I. type PRA-1 455 variable KC.
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8 OHMs 5 watts flush mounting with attractive bakelite cover plate mounting screws and 6ft connecting wire $4.50 ea or two for $8.50.
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Sets of two with 14" connecting wire. 5 sets for $1. Post 24c.

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Output: 35 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.15%. **Frequency response:** 10-35,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $419.

SANSUI — AU-6600.
Output: 45 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.15%. **Frequency response:** 10-40,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $469.

SANSUI — AU-7700.
Output: 55 watts RMS per channel into 8 ohm speaker systems. **THD:** Less than 0.1%. **Frequency response:** 10-50,000 Hz. +0.5, −1 dB. Sensitivity suits magnetic cartridges, tuners, tape decks, etc. **Recommended list price:** $549.

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Atkins Carlyle Limited, 1-9 Milligan St., Perth, 6000. Tel. 22 0191.
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